

Weight descent curves in term newborns during the first 48 post-natal hours, feed with exclusive breast milk

Curvas de descenso de peso en recién nacidos a término durante las primeras 48 horas post natales

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What do we know about the subject matter of this study?

In the first days of life, neonates present physiological weight loss. There is no certainty as to what constitutes normal weight loss, which causes morbidity and rehospitalization. Thus, identifying normal weight loss is relevant, justifying complementary breastfeeding.

What does this study contribute to what is already known?

This article provides plotting curves of the weight loss of breastfed infants during the first two days after birth, using data obtained retrospectively and developing a quadratic polynomial that models the relative weights, estimating the percentiles of weight loss variations.

Abstract

The healthy newborn (NB) experiences physiological weight loss in her/his first days of life. Identifying normal weight loss in this period is relevant since it allows the clinician to make decisions in relation to the need to supplement breastfeeding. **Objectives:** To determine the curves that graph the weight loss experienced by healthy newborns exclusively breastfed during the first 48 hours after birth. **Patients and Method:** Retrospective and analytical descriptive study in healthy full-term NBs during their stay in the nursery, exclusively breastfed, and with mixed feeding. Weights were recorded at birth and on the first and second day of life. A quadratic polynomial was used to model the relative weights. The percentiles of the variations in weight loss were estimated. **Results:** The sample consists of 4331 NBs with an average gestational age of 38.84 weeks. Of these, 56.45% were vaginal deliveries and 43.55% cesarean sections. The distribution by sex was 49.37% male and 50.63% female. Regarding adequacy, 82.96% were adequate for gestational age, 6.33% were small for gestational age, and 10.71% were large for gestational age. The greatest weight loss was observed in the first 12

Keywords:

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hours of life. **Conclusions:** A weight loss graph is obtained for the first 48 hours of life, representing the weight loss per hour for healthy term NB exclusively breastfed. These curves can be used as a decision-making tool to categorize the weight loss of the NB and help in decision making regarding the indication to add artificial feeding.

Introduction

The first postpartum week is a critical period for the establishment of breastfeeding¹. The newborn during its first days of life receives only small amounts of fluids², initially colostrum and then mature breast milk, thus experiencing a period of progressive weight loss immediately after birth³.

In term newborns (TNB), a physiological weight loss is expected, mainly representing fluid redistribution caused by cardiopulmonary adaptation^{4,5}. If this weight loss is excessive, it could be a warning sign of inadequate intake due to low milk production, or a transfer deficit⁶. In some NBs, it may also involve fat loss attributable to a catabolic state, as in the case of small for gestational age NBs, or attributable to late initiation of breastfeeding. However, there are still conflicting data on the nature of the weight loss of NBs and alterations in body composition in the first week of life^{4,6,7}.

There is no certainty as to what actually constitutes normal neonatal weight loss during the first days of life⁶; despite being a known phenomenon, evidence-based data are controversial. Normally, the amount of milk produced between 36 and 96 hours postpartum is minimal but increases dramatically at two to three days after birth⁸. The mammary gland is inactive during pregnancy, but ready to initiate abundant milk secretion around delivery⁹. This inaction period depends on the presence of high levels of circulating progesterone; birth produces a drop in progesterone levels, initiating stage II lactogenesis with the onset of abundant milk secretion, and an increase in prolactin⁹⁻¹¹.

Adequate support of exclusive breastfeeding implies care and monitoring of the mother¹² and careful follow-up of the NB to ensure adequate intake^{13,14} by measuring weight loss, as well as urine production and bowel movements¹⁵.

Associated morbidities such as hyperbilirubinaemia¹⁶ and hyponatremic dehydration^{17,18} are well-known complications of inadequate intake among NBs, which may lead to rehospitalization^{18,19}. Weight measurement in NBs is one of the most frequently used tools for assessing the adequacy of breastfeeding⁶.

The identification of normal weight loss is relevant as it allows the clinician to make decisions in relation to supplementing breastfeeding. The objective of this

study is to determine the plotting curves of the hourly weight loss experienced by NBs during the first 48 hours of life and who remain in the nursery exclusively breastfed.

Patients and Method

Retrospective and analytical study of healthy NBs, exclusively breastfed and mixed-fed during their stay in the nursery.

The nursery, also referred to as puerperium, is the clinical instance where the care and control of the healthy NB are carried out from birth to medical discharge. During this period, the newborn stays with her/his mother in an individual or shared room 24 hours a day. It is under the responsibility of midwives and paramedical technicians trained in the control and care of the mother-child binomial.

The information was obtained between March and December 2017. A total of 4570 newborns were registered, and 239 were eliminated due to various reasons (incomplete information, hospitalization, malformation affecting lactation, genopathies, twins, preterm < 37 weeks). The final sample consisted of 4331 NBs from the Neonatology Service of the *Clínica Dávila*, in Santiago. The weight data were collected from the electronic clinical record of the newborn, where the type of feeding, sex, type of delivery, gestational age, and adequacy at birth were recorded. In addition, it was recorded whether she/he received only breast milk or additional milk formula during the days she/he was in the nursery.

All newborns were in follow-up for at least 48 hours, recording birth weight, as well as on the first and second day of birth. The first weighing was at birth; the second weighing was the immediately subsequent measurement during the first 12 or 24 hours after birth according to the time of day of birth, that is, all patients born between 8:00 and 23:59 hours were weighed between 8:00 and 12:00 hours of the following day and those born between 0:00 and 7:59 hours were weighed from 8:00 hours of the following day. Finally, the third weighing was performed from 8:00 a.m. the following day. Thus, the second weighing was between 0.5 and 1.5 days of the birth weight and the third weighing was between 2.0 and 2.5 days after birth. All weight measu-

rements were performed using a Seca Model 334 digital scale. The weight measurements at follow-up were then transformed into percentages of birth weight. Weight recording time was in units of half days.

Continuous variables were described as mean and standard deviation and categorical variables as frequencies and percentages. The weight measurements of the NBs were transformed into percentage relative weights with respect to their birth weights. The evolution of the relative weights was modeled using a quadratic polynomial whose coefficients were estimated using mixed models. This same strategy was used to compare the differences in the evolution of the NBs according to gestational age, type of delivery, sex, and type of feeding. The percentage variations observed over time were transformed into percentiles. All confidence intervals were at the 95% level and a significance level of 5% was used. Data were processed in the statistical software STATA version 16.0.

Results

The total sample consisted of 4331 NBs. Figure 1 (Table A) shows the descriptive statistics of the variables studied. The mean gestational age was 38.84 ± 0.95 weeks (range 37 to 41 weeks). 2445 (56.45%) were vaginal deliveries and 1886 (43.55%) cesarean sections. Regarding sex, 2138 (49.37%) were female and 2195 (50.63%) were male. As for adequacy for gestational age, 3593 (82.96%) were adequate (AGA), 274 (6.33%) small (SGA), and 464 (10.71%) large (LGA).

The average weight loss in the first 24 hours was 4.49%, on the second day was 2.69% with respect to the first day, and 7.08% was the total weight loss in the first 48 hours.

In the analysis according to the type of feeding, 2538 NB were exclusively breastfed, with an average gestational age of 38.81 ± 0.93 weeks (range 37 to 41 weeks). Of these, 1444 (56.9%) were vaginal deliveries, and 1094 (43.1%) were cesarean deliveries. In relation to sex, 1253 (49.37%) were male and 1285 (50.63%) female. Regarding the adequacy for gestational age, 2098 (82.67%) were AGA, 159 (6.26%) were SGA, and 281 (11.07%) were LGA. The average weight loss in the first 24 hours was 4.43%, on the second day was 2.72% with respect to the first day, and the weight loss in the first 48 hours was 7.04%.

The total number of mixed feedings was 1793 NBs, with an average gestational age of 38.84 ± 0.97 weeks (range 37 to 41 weeks). Of these, 1001 (55.83%) were vaginal deliveries, and 792 (44.17%) were cesarean deliveries. The distribution by sex was 885 (49.36%) male and 908 (50.64%) female. Regarding gestational age adequacy, 1495 (83.38%) were AGA, 115 (6.42%) were

SGA, and 183 (10.2%) were LGA. The average weight loss in the first 24 hours was 4.59%, the second day was 2.65% with respect to the first day, and the total weight loss in the first 48 hours was 7.13%.

In relation to the number of times they received additional milk formula, 829 NBs received formula only once (46.23%); 404 twice (22.53%), 205 three times (11.43%), and the rest of the patients (19.8%) received formula between four and 20 times. The reasons were due to maternal request, poor maternal conditions, low weight, low serum glucose level, and the newborn's appetite.

When analyzing the risk factors affecting low birth weight in the total sample (Figure 1, Table B), there was no significant difference in sex, parity, and the number of bottles; however, vaginal or cesarean birth did significantly modulate this evolution ($p = 0.000$). The SGA condition also showed a significant difference with respect to AGA and LGA ($p = 0.000$).

The relative weight prediction equations by type of delivery are as follows:

Vaginal delivery:

$$\text{Relative weight} = 100 - 5.97t + 1.33t^2$$

Cesarean delivery:

$$\text{Relative weight} = 100 - 7.31t + 1.84t^2$$

Where t represents the time, measured in hours, since delivery of the NB.

The average percentage of weight loss in the total number of NBs was 3.45%, 5.8%, 7.12%, and 7.93% at 12, 24, 36, and 48 hours of life, respectively. The greatest weight loss was observed on the first day of life, being more accentuated in the first 12 hours, corresponding to 43.5% of the total weight loss in the first 2 days (Figure 2, graph A).

The relative weights disaggregated by type of delivery show that the average percentage of weight loss in NBs delivered vaginally was 3.25%, 5.51%, 6.84%, and 7.59% at 12, 24, 36, and 48 hours of life, respectively. The greatest weight loss was observed on the first day of life, being more accentuated in the first 12 hours, corresponding to 42.8% of the total weight loss in the first 2 days (Figure 2, graph B).

In the NBs delivered by cesarean section, the average percentage of weight loss was 3.68%, 6.09%, 7.49%, and 8.29% at 12, 24, 36, and 48 hours of life, respectively. The greatest weight loss was observed on the first day of life and was also more accentuated in the first 12 hours, corresponding to 44.39% of the total weight loss in the first two days (Figure 2 graph C).

Graph D (Figure 2) shows the curves of the relative weight evolution, which combines and compares the percentage weight loss curves of vaginal and cesarean delivery for the total of the patients studied, where it

Table A. Variables studied

	TOTAL		EXCLUSIVELY BREASTFED		MIXED-FED		
	Freq.	Percent	Freq.	Percent	Freq.	Percent	
GESTATIONAL AGE	37	350	8.08	200	7.88	150	8.37
	38	1267	29.25	741	29.20	526	29.34
	39	1579	36.46	964	37.98	615	34.30
	40	1050	24.24	590	23.25	460	25.66
	41	85	1.96	43	1.69	42	2.34
TYPE OF DELIVERY	Total	4331	100.00	2538	100.00	1793	100.00
	Vaginal	2138	49.37	1248	49.17	890	49.64
	Cesarean	1886	43.55	1094	43.10	792	44.17
	Spatula	260	6.00	164	6.46	96	5.35
	Forceps	47	1.09	32	1.26	15	0.84
GENDER	Total	4331	100.00	2538	100.00	1793	100.00
	Female	2138	49.37	1285	50.63	908	50.64
	Male	2195	50.63	1253	49.37	885	49.36
ADQUACY	Total	4331	100.00	2538	100.00	1793	100.00
	Adequate	3593	82.96	2098	82.67	1495	83.38
	Small	274	6.33	159	6.26	115	6.42
	Large	464	10.71	281	11.07	183	10.2
USE OF MILK FORMULA	Total	4331	100.00	2538	100.00	1793	100.00
	Exclusively breastfed	2538	58.60				
	Mixed feeding	1793	41.40				
	Total	4331	100.00				

Table B. Risk factor for weight loss

	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]
Cesarean	-.452899	.0337856	-13.59	0.000	-.5255085 -.3930714
SGA	.2979868	.0689526	4.32	0.000	.1628423 .4331314
Female	-.1024079	.0337014	-3.04	0.002	-.1684615 -.0363544
Primigravida	.0879122	.0338548	2.60	0.009	.0215579 .1542664
Number of bottles	-.0051853	.0093158	-0.56	0.578	-.0234439 .0130733
Cons	99.42796	.0376088	2643.74	0.000	99.35425 99.50167

Table C. Number of weight measurements, at each time

Hours	Total Sample	Vaginal Birth	Cesarean section	SGA	No SGA
0	4331	2445	1886	274	4057
12	1711	870	841	121	1590
24	4319	2386	1933	270	4049
36	3771	1844	1427	211	3060
48	1751	914	837	116	1635
60	390	205	185	28	362
72	42	16	26	4	38
84	10	3	7	2	8
96	1	1			1

Figure 1. Total Sample.

is observed that the NBs born by cesarean delivery, in the first 24 hours lose, time by time, more weight than the NBs born by vaginal delivery. The differences in the percentage of weight loss appear early and are clearly evident at 12 hours of life. The curve of percentage weight loss of NBs born by cesarean section is clearly steeper than the curve of NBs born vaginally, which is maintained during the first two days.

The relative weights disaggregated according to gestational age adequacy, comparing SGA vs Non-SGA patients, show that the percentage of weight loss in SGA NBs was 3.38%, 5.72%, 6.71%, and 7.45% at 12, 24, 36, and 48 hours of life, respectively. The greatest weight loss also occurred on the first day, being more accentuated in the first 12 hours, which corresponds to 45.36% of the total weight loss in the first two days (Figure 3, graph A).

In AGA and LGA NBs, the average percentage of weight loss was 3.46%, 5.8%, 7.15%, and 7.95% at 12, 24, 36, and 48 hours of life, respectively. The greatest weight loss is also on the first day, being more accentuated in the first 12 hours, which corresponds to 43.52% of the total weight loss in the first two days (Figure 3 graph B).

Graph C (Figure 3) combines the graphs of the percentage weight loss curves of SGA vs. non-SGA infants and shows that SGA infants lose less weight than non-SGA infants and then slow down their weight loss curve after 24 hours of birth, which does not occur with non-SGA infants, who maintain a descending curve, making the two curves clearly separate.

The analysis of relative weights of exclusively breastfed patients shows that the average percentage of weight loss was 3.37%, 5.75%, 7.12%, and 7.89% at 12, 24, 36, and 48 hours of life, respectively. The greatest weight loss was observed on the first day of life, being more accentuated in the first 12 hours, which corresponds to 42.71% of the total weight loss in the first two days (Figure 4, graph A).

When analyzing the risk factors influencing weight loss in breastfed patients (Figure 5, Table A), there were no significant differences in sex, gestational age, or parity; however, the type of delivery did significantly modulate this evolution ($p = 0.000$).

The average percentage of weight loss in NBs delivered vaginally was 3.12%, 5.49%, 6.85%, and 7.52% at 12, 24, 36, and 48 hours of life, respectively. The greatest weight loss was observed on the first day of life, being more accentuated in the first 12 hours, and corresponded to 41.48% of the total weight loss in the first two days. At 48 hours of life, weight loss slows down and the curve becomes flatter with a very slight decrease (Figure 4, graph B).

The average percentage of weight loss in NBs born by cesarean section was 3.59%, 6.02%, 7.47%, and

8.36% at 12, 24, 36, and 48 hours of life. The greatest decrease in weight was observed on the first day and was also more accentuated in the first 12 hours, corresponding to 42.94% of the total weight loss in the first two days. At 48 hours of life, there is an inflection point in the curve in which the decrease tends to slow down, becoming less pronounced and tends to flatten, similar to what is observed in the curve of those born vaginally (Figure 4, Graph C).

Graph D (Figure 4) combines the graphs of the percentage weight loss curves of NBs born by vaginal delivery and cesarean section and shows that NBs born by cesarean section, in the first 24 hours, lose more weight over time than NBs born by vaginal delivery. The differences in weight loss appear early and are evident at 12 hours of life. The curve of percentage of weight loss in NBs delivered by cesarean section is clearly steeper than the curve of NBs delivered vaginally, which is maintained over time.

Discussion

It is known that healthy NBs experience physiological weight loss in the first days of life²⁰. During this period, they are exclusively breastfed, so enteral intake is low during the time of colostrum production^{21,22}.

There are contradictory data regarding the nature of weight loss in newborns⁶, which is why we previously developed a prospective cohort study analyzing 2960 newborns, in order to know our reality regarding the weight loss of newborns in the nursery²³. We observed 4.43% weight loss on the first day, 2.51% on the second day with respect to the first day, and a total weight loss of 6.85% in the first 48 hours²³, similar to what is found in the international literature^{6,16,24-26}. We felt the need to find an objective tool to show the trajectory of weight loss in newborns during the first days after birth, which would contribute to clinical practice and allow us to make decisions in relation to complementary breastfeeding.

This study shows that the weight loss in the first 48 hours after birth in healthy NBs exclusively breastfed was 7.04%, similar to that reported in previous and international studies^{6,16,23,27,28}. The greatest weight loss was 4.43% on the first day, in agreement with previous studies²³ and the literature^{6,16,23,27,28}. Michel et al. report the lowest weight loss between the first and second day²⁹ and Muskinja-Montanji et al. between the second and third day³⁰; this discrepancy in days was apparently due to considering the day of birth as day 0 or day 1 and then the second 24 hours as day 1 or 2. The average weight loss between the first and second day was 2.72%, similar to that described in our study²³.

The analysis of NB with mixed feeding showed that

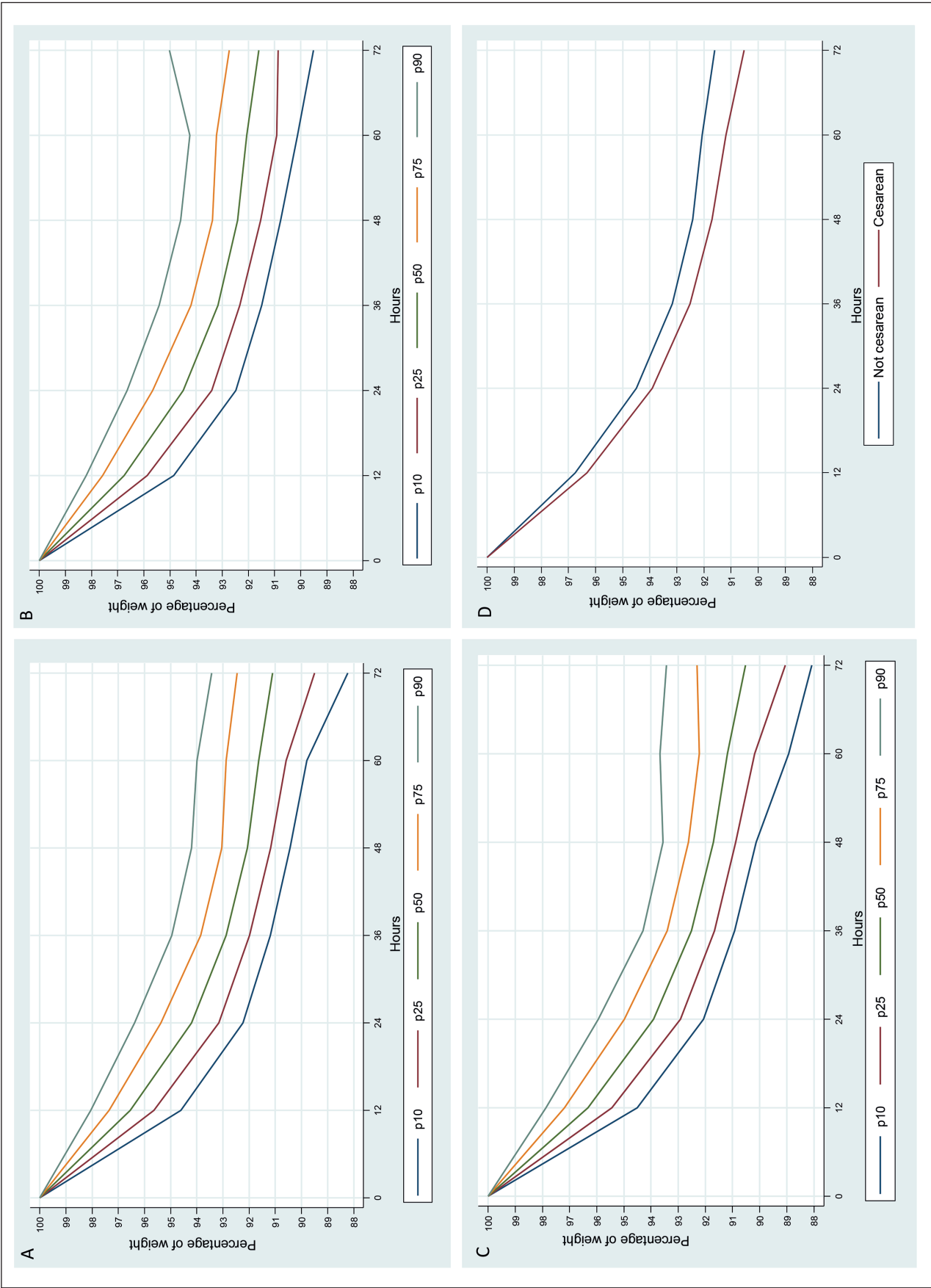


Figure 2. Weight Loss Curves. Total Sample. **A)** Evolution of relative weights. Total. **B)** Evolution of relative weights. Vaginal Birth **C)** Evolution of relative weights. Cesarean Delivery **D)** Evolution of relative weights. Cesarean section v/s Vaginal.

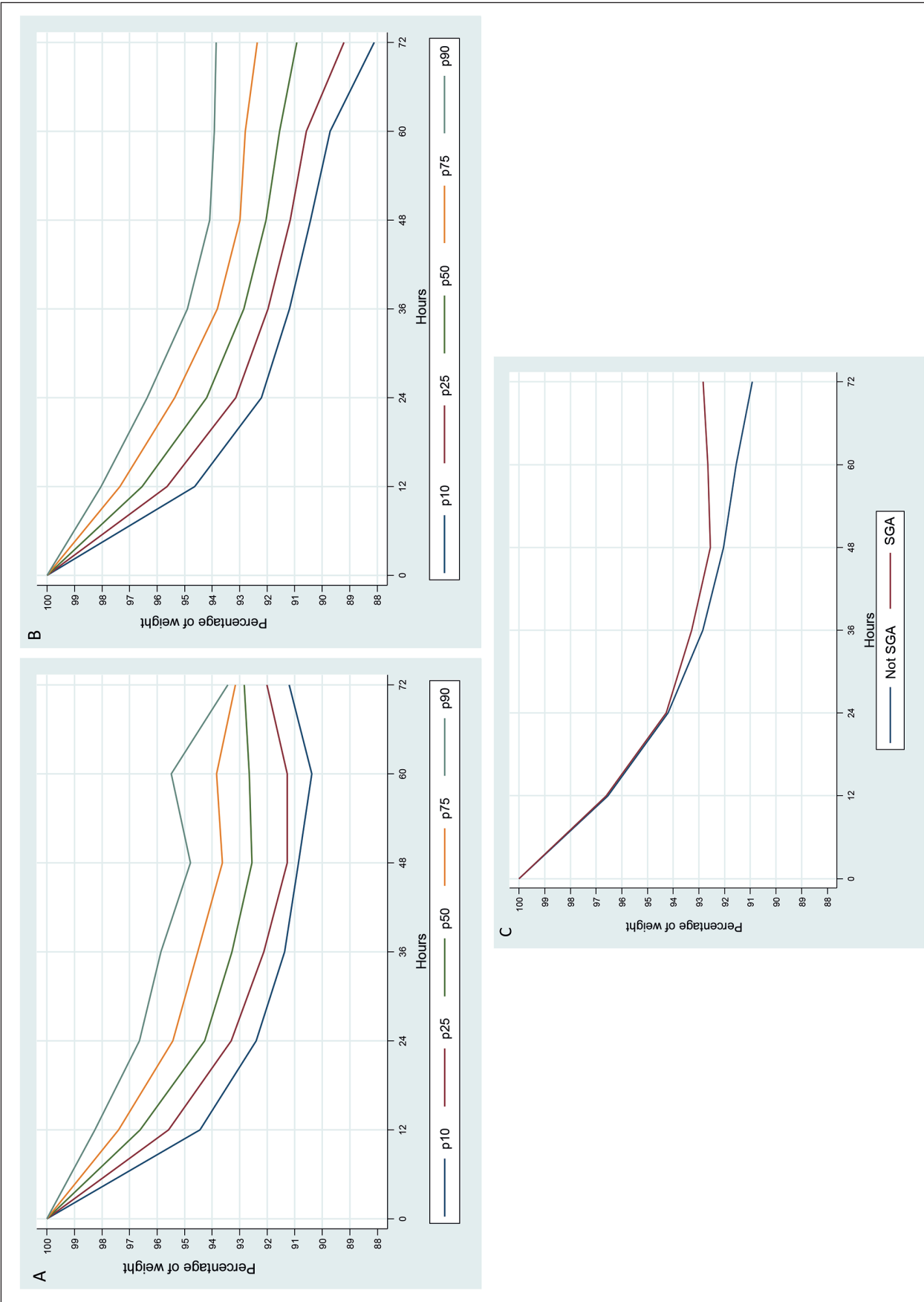


Figure 3. Weight loss curves according to gestational age adequacy. Total sample **A**) Evolution of relative weights. NB SGA **B**) Evolution of relative weights. NB No SGA **C**) Evolution of relative weights. Combined Curves SGA v/s No SGA.

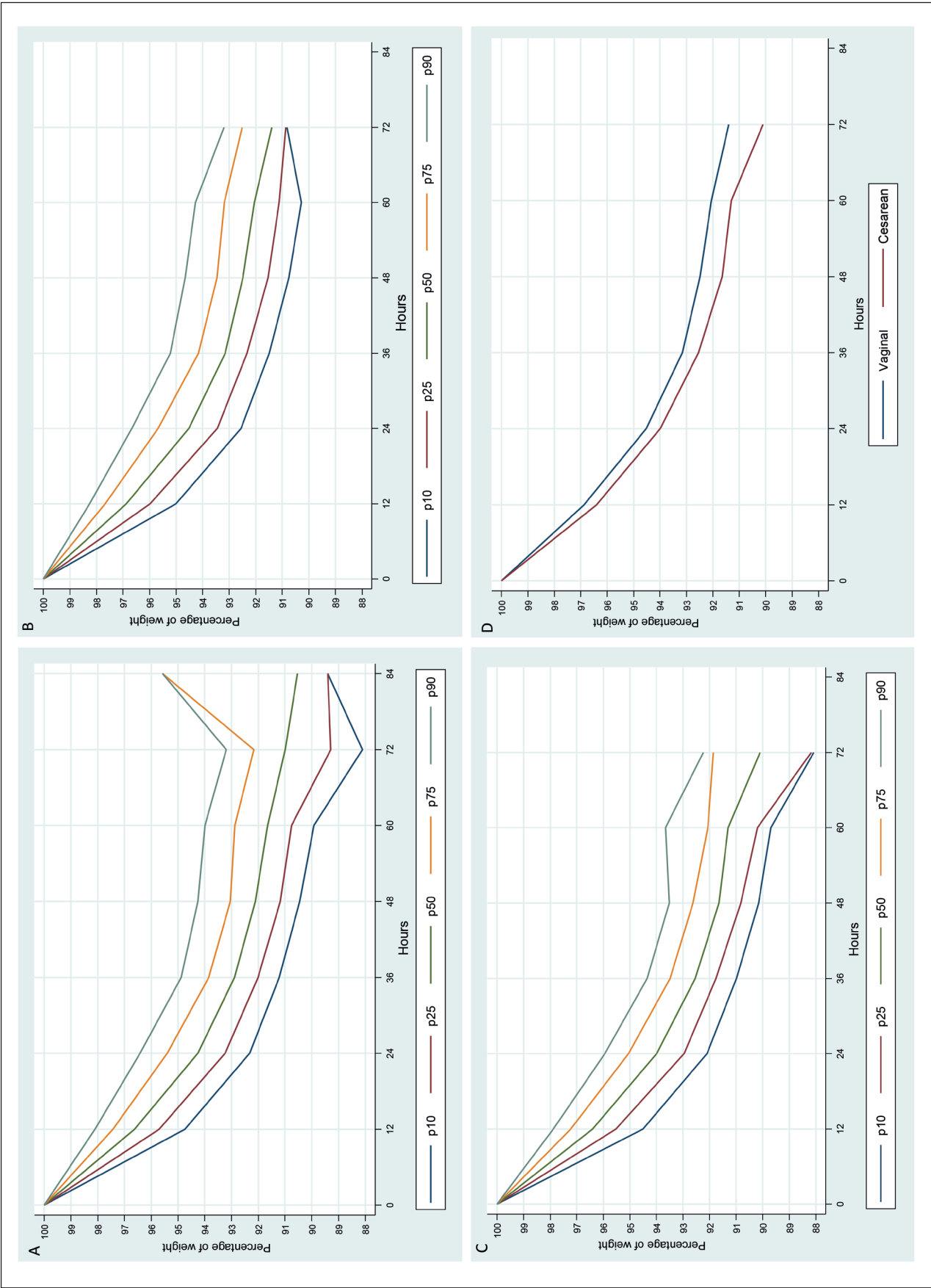


Figure 4. Weight loss curves in newborns with exclusive breast milk. **A)** Evolution of relative weights. Vaginal Birth. **B)** Evolution of relative weights. Cesarean Delivery. **C)** Evolution of relative weights. Vaginal Birth. **D)** Evolution of relative weights. Cesarean Delivery.

	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
Female	-.146726	.072704	-2.02	0.044	-.2892232	-.0042
Primigravida	.1137687	.0731519	1.56	0.120	-.0296064	.2571
Cesarean	-.5361154	.0729988	-7.34	0.000	-.6791904	-.3930
SGA	.3628387	.150183	2.42	0.016	.0684855	.6571
Cons	95.7852	.0698534	1371.23	0.000	95.64829	95.92

	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
Female	-.146726	.072704	-2.02	0.044	-.2892232	-.0042
Primigravida	.1137687	.0731519	1.56	0.120	-.0296064	.2571
Cesarean	-.5361154	.0729988	-7.34	0.000	-.6791904	-.3930
SGA	.3628387	.150183	2.42	0.016	.0684855	.6571
Cons	95.7852	.0698534	1371.23	0.000	95.64829	95.92

Figure 5. Exclusively breastfed newborn.

the weight loss in the first 48 hours was 7.13%, the greatest weight loss was 4.59% on the first day of life, and 2.65% between the first and second day, similar to previous studies²³. In the total sample, the weight loss was 7.08% in the first 48 hours, the greatest weight loss was 4.49% on the first day, and 2.69% between the first and second day, similar to previous studies and the literature^{6,16,23-26}.

The first 12 hours specifically stand out as the time of greatest weight loss, 3.2% on average, equivalent to almost half of the total weight loss in the first 48 hours. This observation should be contemplated when defining what is considered normal weight loss.

When analyzing the factors associated with greater weight loss in patients exclusively breastfed, there were no significant differences in sex, gestational age, and adequacy for gestational age; however, the type of delivery did show significant differences, in agreement with the literature that describes cesarean section as associated with greater weight loss^{17,31-33}. Cesarean section has been described as a risk factor for suboptimal breastfeeding, delayed initiation of breastfeeding³¹⁻³³,

and excess weight loss in the NB¹⁷. One study described that a cesarean delivery was 2.42 times more likely to result in excess neonatal weight loss³⁴. The association of cesarean section with greater weight loss suggests that antepartum factors such as maternal hydration may affect postnatal weight loss in breastfed NBs^{15,16,35}. We observed that NBs born by cesarean section lose more weight than NBs born vaginally, with a steeper curve of weight loss and an earlier slope than the curve of those born vaginally.

When analyzing the total sample, gestational age adequacy appears as another risk factor. Birth weight appears to be an important determinant of immediate neonatal low birth weight, as it is positively associated, i.e., the smaller the infant at birth, the lower the low birth weight^{24,36,37}. This result may reflect some growth recovery, a phenomenon of accelerated growth compared with the normal rate for age, after a period of growth inhibition conditions, which is frequent in NBs with low birth weight³⁸.

We provide the first graphical representation in Chile of weight loss per hour for healthy exclusively breastfed NBs. These graphs are similar to those published by Flaherman et al.³⁹, which show weight loss curves in exclusively breastfed NBs > 36 weeks³⁹.

Among the aspects to be improved or limitations of our study are that not all patients were discharged after 2.5 days, so the analysis can only be performed in the first 48 hours, since after that the sample decreases markedly, which prevents a more objective analysis. Another limitation is not having weighed all the NBs every 12 hours, which would improve the accuracy of the curve.

There are other risk factors described in the literature that influence weight loss and lactation, such as maternal age or the mother's educational level, which were not measured because they were not included in the variables studied, representing another limitation of the study.

In relation to the strengths of the study, the sample size and the fact that the NBs had a high number of measurements in the first 48 hours are noteworthy (Figure 1 Table C and Figure 5 Table B) in addition to providing weight loss data for NBs with mixed feeding.

As a strength, this study reported a cesarean section rate in *Clínica Dávila* in 2017 of 48% and a national rate of 41%⁴⁰, which allows extrapolation of our results to other populations.

These graphs are a new decision-making tool and will help physicians and professionals responsible for the newborn in the nursery to categorize weight loss and calibrate the decision-making process regarding the indication to add artificial feeding to the infant's diet. The population treated at *Clínica Dávila* can be extrapolated to the FONASA beneficiary population, which corresponds to 78% of the national popula-

tion⁴¹. Observing that a newborn falls out of the normal trend of weight loss will allow the clinician to take measures to avoid exaggerated weight loss and future complications, and to contribute to the early identification of feeding difficulties.

These curves provide an objective indicator of weight loss in healthy infants exclusively breastfed, which should be considered when creating guidelines to promote and strengthen breastfeeding, without rushing into the initiation of formulas that may be detrimental to exclusive breastfeeding, thus altering the necessary and indispensable early factors for safe breastfeeding.

Ethical Responsibilities

Human Beings and animals protection: Disclosure the authors state that the procedures were followed according to the Declaration of Helsinki and the World Medical Association regarding human experimentation developed for the medical community.

Data confidentiality: The authors state that they have followed the protocols of their Center and Local regulations on the publication of patient data.

Rights to privacy and informed consent: The authors have obtained the informed consent of the patients and/or subjects referred to in the article. This document is in the possession of the correspondence author.

Conflicts of Interest

Authors declare no conflict of interest regarding the present study.

Financial Disclosure

Authors state that no economic support has been associated with the present study.

References

- Dewey K, Nommsen-Rivers L, Heinig MJ, et al. Risk factors for suboptimal infant breastfeeding behavior, delayed onset of lactation, and excess neonatal weight loss. *Pediatrics* 2003;112(3Pt 1):607-19.
- Hartmann PE. Lactation and reproduction in Western Australian women. *J Reprod Med*. 1987;32(7):543-7.
- Lawrence RA, Lawrence RM. *Mosby*. St. Louis (MO): Mosby 1999.
- Modi N, Betremieux P, Midgley J, et al. Postnatal weight loss and contraction of the extracellular compartment is triggered by atrial natriuretic peptide. *Early Hum Dev*. 2000;59(3):201-8.
- Singhi S, Sood V, Bhakoo ON, et al. Composition of postnatal weight loss and subsequent weight gain in preterm infants. *Indian J Med Res*. 1995;101:157-62.
- Noel-Weiss J, Courant G, Woodend AK. Physiological weight loss in the breastfed neonate a systematic review. *Open Medicine* 2008;2(4):e99- e110
- Sulyok E. Physical water compartments: A revised concept of peri- natal body water physiology. *Physiol Res*. 2006;55(2):133-8.
- Neville MC, Allen JC, Archer P, et al. Studies in human lactation: milk volume and nutrient composition during weaning and lactogenesis. *Am. J. Clin. Nutr*. 1991;54:81-93.
- Neville MC, Morton J. Physiology and endocrine changes underlying human lactogenesis II. *J Nutr*. 2001;131(11):3005S-8S.
- Hartmann PE. Changes in the composition and yield of the mammary secretion of cows during the initiation of lactation. *J. Endocrinol*. 1973;59:231-47.
- Neville MC, Morton JA, Umemora S. Lactogenesis: the transition between pregnancy and lactation. *Pediatr. Clin. North Am*. 2001;48:35-52.
- World Health Organization, Division of Child Health and Development. Evidence for the Ten Steps to Successful Breastfeeding. Geneva, Switzerland: World Health Organization; 1998. Publication WHO/CHD/98.9
- American Academy of Pediatrics, Section on Breastfeeding. Breastfeeding and the use of human milk. *Pediatrics*. 2005;115(2):496-506.
- Academy of Breastfeeding Medicine, Clinical Protocol Committee. Guidelines for hospital discharge of the breastfeeding mother and term infant: "the going home protocol." *Breastfeed Med*. 2007;2(3):158-65.
- Chantry CJ, Nommsen-Rivers LA, Pearson JM, et al. Excess weight loss in first-born breastfed newborns relates to maternal intrapartum fluid balance. *Pediatrics* 2011;127(1):e171-9.
- Maisels MJ, Gifford K, Antle CE, et al. Jaundice in the healthy newborn infant: a new approach to an old problem. *Pediatrics*. 1988;81(4):505-11.
- Manganaro R, Mami C, Marrone T, et al. Incidence of dehydration and hypernatremia in exclusively breast-fed infants. *J Pediatr*. 2001;139(5):673-5.
- Escobar GJ, Gonzales VM, Armstrong MA, et al. Rehospitalization for neonatal dehydration: a nested case-control study. *Arch Pediatr Adolesc Med*. 2002;156(2):155-61.
- Moritz ML, Manole MD, Bogen DL, et al. Breastfeeding-associated hypernatremia: are we missing the diagnosis? *Pediatrics*. 2005;116(3). Available at: www.pediatrics.org/cgi/content/full/116/3/e343.
- Wright CM, Parkinson KN. Postnatal weight loss in term infants: ¿what is normal and do growth charts allow for it? *Arch Dis Child Fetal Neonatal Ed*. 2004;89(3):F254-7.
- Slusher TM, Slusher IL, Keating EM, et al. Comparison of maternal milk (breastmilk) expression methods in an African nursery. *Breastfeed Med*. 2012;7(2):107-11.
- Saint L, Smith M, Hartmann PE. The yield and nutrient content of colostrum and milk of women from giving birth to 1-month post-partum. *Br J Nutr*. 1984;52(1):87-95.
- Gallardo LM, Gallardo CE, Gallardo CL. Weight decrease in full-term newborns in the first 48 hours postnatal. *Rev Chil Pediatr*. 2018;89(3):325-31.
- Fonseca MJ1, Severo M, Barros H, et al. Determinants of weight changes during the first 96 hours of life in full-term

- newborns. *Birth*. 2014;41(2):160-8. doi: 10.1111/birt.12087. Epub 2014.
25. Macdonald PD, Ross SR, Grant L, et al. Neonatal weight loss in breast and formula fed infants. *Arch Dis Child Fetal Neonatal Ed*. 2003;88(6):F472-6.
 26. Dewey K, Nommsen-Rivers L, Heinig MJ, et al. Risk factors for suboptimal infant breastfeeding behavior, delayed onset of lactation, and excess neonatal weight loss. *Pediatrics* 2003;112(3Pt 1):607-19.
 27. Maisels MJ, Gifford K. Breast-feeding, weight loss, and jaundice. *J Pediatric* 1983;102(1):117-18.
 28. Chantry CJ, Nommsen-Rivers LA, Pearson JM, et al. Excess weight loss in first-born breastfed newborns relates to maternal intrapartum fluid balance. *Pediatrics* 2011;127(1):e171-9.
 29. Michel M-P, Gremmo-Feger G, Oger E, et al. Pilot study of early breastfeeding difficulties of term newborns: incidence and risk factors. *Arch Pediatr*. 2007;14(5):454-60.
 30. Muskinja-Montanji G, Molnar-Sabo I, Vekonj-Fajka G. Physiologic neonatal body weight loss in a "baby friendly hospital". *Med Pregl*. 1999;52(6-8):237-40.
 31. Chapman DJ, Pérez-Escamilla R. Identification of risk factors for delayed onset of lactation. *J Am Diet Assoc*. 1999;99(4):450-4.
 32. Hildebrandt HM. Maternal perception of lactogenesis time: a clinical report. *J Hum Lact*. 1999;15(4):317-23.
 33. Vestermark V, Hogdall CK, Birch M, et al. Influence of the mode of delivery on initiation of breast-feeding. *Eur J Obstet Gynecol Reprod Biol*. 1991;38(4):33-8.
 34. Regnault N, Botton J, Blanc L, et al. Determinants of neonatal weight loss in term-infants: specific association with pre-pregnancy maternal body mass index and infant feeding mode. *Arch Dis Child Fetal Neonatal Ed*. 2011;96(3):F217-22.
 35. Dewey K, Nommsen-Rivers L, Heinig MJ, et al. Risk factors for suboptimal infant breastfeeding behavior, delayed onset of lactation, and excess neonatal weight loss. *Pediatrics* 2003;112(3Pt 1):607-19.
 36. Martens PJ, Romphf L. Factors associated with newborn in-hospital weight loss: Comparisons by feeding method, demographics and birthing procedures. *J Hum Lact*. 2007;23(3):233-41,quiz 42-5.
 37. Regnault N, Botton J, Blanc L, et al. Determinants of neonatal weight loss in term-infants: Specific association with pre - pregnancy maternal body mass index and infant feeding mode. *Arch Dis Child Fetal Neonatal Ed*. 2011;96(3):F217-F222.
 38. Gafni RI, Baron J. Catch-up growth: Possible mechanisms. *Pediatr Nephrol*. 2000;14(7):616-9.
 39. Flaherman VJ, Schaefer EW, Kuzniewicz MW, et al. Early weight loss nomograms for exclusively breastfed newborns. *Pediatrics*. 2015;135(1):e16-23.
 40. Norma de Vigilancia y monitoreo de la indicación de cesárea. Programa Nacional de Salud de la Mujer. Subsecretaría de Salud Pública. Ministerio de Salud. 29 de abril 2019. Gobierno de Chile.
 41. División de Desarrollo Institucional, D. d. Informe CDD: Caracterización sociodemográfica y socioeconómica en la población asegurada inscrita. Santiago: Gobierno de Chile 2020.