The implications of breastfeeding for maternal time use

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Abstract

Breastfeeding is a long-standing, widely endorsed practice that is typically carried out in private; however, little is known about its time implications for the milk-producing parent (hereafter, mother). To study how milk production shapes maternal time use, we analyze 203 million high-frequency, time-stamped nursing and pumping events logged for 246,157 infants in a smartphone tracking app. During the first 90 days postpartum, mothers spend a daily median of 137 minutes across 9 sessions. The median mother has only one uninterrupted three-hour daytime block and experiences two nightly milk-production disruptions. Although daily minutes decline over the year, we estimate a cumulative total of 39,621 min ($\sim$ 17 standard work-weeks), with a median value of time of \$9,386. Replacing nursing with exclusive formula use rarely reduces total feeding time because bottle-feeds tend to be slower, but for the average mother it converts about 93% of currently non-outsourceable time into shareable tasks. These findings make the hidden labor of lactation visible, offering quantitative benchmarks that can guide leave policy, workplace accommodations, and the division of caregiving within households.

1 Introduction

Breastfeeding is as old as humankind [Austin et al., 2013, Joannes-Boyau et al., 2019, Bode et al., 2020] and remains widely practiced and encouraged [UNICEF and World Health Organization, 2025, Centers for Disease Control and Prevention, 2023]. International and national health authorities, including the World Health Organization (WHO) and the American Academy of Pediatrics (AAP), recommend exclusive breastfeeding for the first six months, followed by complementary foods can be introduced [World Health Organization, 2024]. In 2022, the AAP extended its guidance to support breastfeeding for at least two years [Meek et al., 2022], echoing benchmarks set by the WHO and other leading health organizations [World Health Organization, 2025]. While much research and discussion has focused on the consequences of breastfeeding for infants and the mother–child bond [Victora et al., 2016, Oster, 2013, Horta and Victora, 2013, Fitzsimons and Vera-Hernández, 2022], less is known about its direct implications for mothers.

This paper focuses on mothers' time use. Specifically, we quantify how much time milk production takes—through nursing and pumped expression—and how it shapes mothers' access uninterrupted time during the day and sleep at night. We estimate the economic value of this time and examine a counterfactual scenario in which feeding becomes outsourceable via formula.

Understanding how milk production shapes mothers' time use is important as time is a finite resource with broad implications for maternal well-being (including postpartum depression), economic opportunities (notably the motherhood wage penalty), and family dynamics [Anderson et al., 2002, Heron et al., 2004, Gavin et al., 2005, Adams et al., 2025, Kleven et al., 2024]. Yet milk production largely occurs in private, and where mothers' time has been considered, researchers and decision-makers have often had to rely on binary breastfeeding indicators at various infant age thresholds, crude approximations of time demands, or small survey samples of self-selected study participants which may lead to biased estimates [Smith and Forrester, 2013, Mahoney et al., 2023]. The existing evidence suggests that the choice to breastfeed affects mothers' income and labor force participation, highlighting the importance of understanding the time demands that might drive these outcomes [Lawler and Yewell, 2023, Rippeyoung and Noonan, 2012]. A systematic quantification of the temporal demands of milk production and how it shapes time use can directly inform policies, workplace practices, and intra-household arrangements [Oster, 2022, Baker and

Milligan, 2008, National Academies of Sciences, Engineering, and Medicine, 2025].

We address this gap by leveraging high-frequency, large-scale smartphone data, capturing millions of milk production events logged for 246,157 infants between 2012 and 2022. By tracking nursing and pumping in both private and public settings, we capture individuals' real-world behavior while minimizing observer effects. In the first 90 days postpartum, mothers logged a median of 137 minutes per day producing milk. During daytime, mothers had a median of one uninterrupted three-hour periods, and at night they experienced a median of two disruptions. Over the first year, daily milk production and frequency declined, while uninterrupted time increased and nighttime disruptions decreased. By year's end, the median time spent was 65 minutes per day, with three uninterrupted three-hour daytime periods and one milk production-related nighttime disruption. The economic value of time in the first year is \$10,520 on average (median \$9,386), based on the 2020 median hourly earnings of women aged 25–34 (\$15.93/hr) [U.S. Bureau of Labor Statistics, 2021]. By switching to exclusive formula feeding and dividing feeding responsibilities according to a 71% (mother)–29% (partner) split in basic child care reported by Guryan et al. [2008], mothers' total feeding-related time (milk production and bottle-feeding) could be reduced by 27%, from 21,323 minutes to 15,556 minutes in the first year. [1]

These results contribute to a growing literature on hidden labor and other sources of gender inequality [see, e.g., Babcock et al., 2017, England et al., 2020]. They come at a time when women face increasingly conflicting expectations—emanating from extended breastfeeding guidelines on one hand, and declining birth rates and rising labor force participation on the other [Goldin, 2006, Bhattacharjee et al., 2024].

2 Quantifying the Time Demands of Milk Production Using Smartphone Data

With widespread smartphone access among new parents [Pew Research Center, 2024], baby-tracking apps are now common, and feeding-related activities are among the most frequently tracked activities [Dinour, 2022, Van Kollenburg et al., 2018, Cimino and Cerniglia, 2023]. Leveraging this shift

[1] Estimates exclude the first 14 days postpartum, consistent with the sample construction described in Supplementary Section B.1, due to irregular logging behavior immediately after birth.

to digital self-tracking, we analyze a high-frequency dataset of millions of nursing and pumping events, allowing minute-level measurement of the temporal demands of milk production in everyday settings. The source app, Baby Connect, is a U.S.-based platform that was launched in 2010 and is available on Android, iOS, and web browsers [Baby Connect]. Its basic tier is free and allows users to log feeding-related activities in real time or retrospectively, with the ability to add optional details such as milk volume or breast side. Records are time-stamped on the device at entry and synchronized to secure cloud storage, yielding a continuous digital log even when caregivers enter data from different devices for the same child. Additional details on the Baby Connect platform, data structure, and external validation are provided in Supplementary Section A.

Our primary unit of analysis is a child-day, defined as all feeding-related activities recorded for a given child within a calendar day (12:00 AM to 11:59 PM). We focus on milk-production activities—nursing and pumping—but later extend the counterfactual analysis to all feeding-related activities, including bottle-feeding time. To limit measurement error, we restrict the sample to only child-days where reporting appears to be complete, yielding 175 million milk-production events from 246,157 infants recorded between 2012 and 2022. The analytical sample is predominantly located in the United States (78% of country-identified observations) but includes children from 172 countries overall. See Supplementary Section B.1 for additional details on the data preparation and sample composition.

While the platform's large-scale, high-frequency smartphone data overcome many limitations of survey methods—such as small samples, observer effects—they also have limitations. First, app users are self-selected parents who track caregiving activities. To gauge how this selection may shape our estimates, we exploit the decade-long span of the data—during which smartphone adoption moved from niche to near-universal—and report all results separately for the first half (2012 - 2017) and second half (2018 - 2022); our headline results remain stable (Supplementary Section D.1). Second, Baby Connect does not collect sociodemographic characteristics, preventing direct assessment of representativeness by parent age, income, or education. Third, users' logging habits vary: users may omit some nursing or pumping sessions (e.g., while at work) or cease tracking altogether once routines stabilize. We mitigate this issue through sample restrictions designed to maximize completeness.

3 Milk Production and Time Use During the First 90 Days

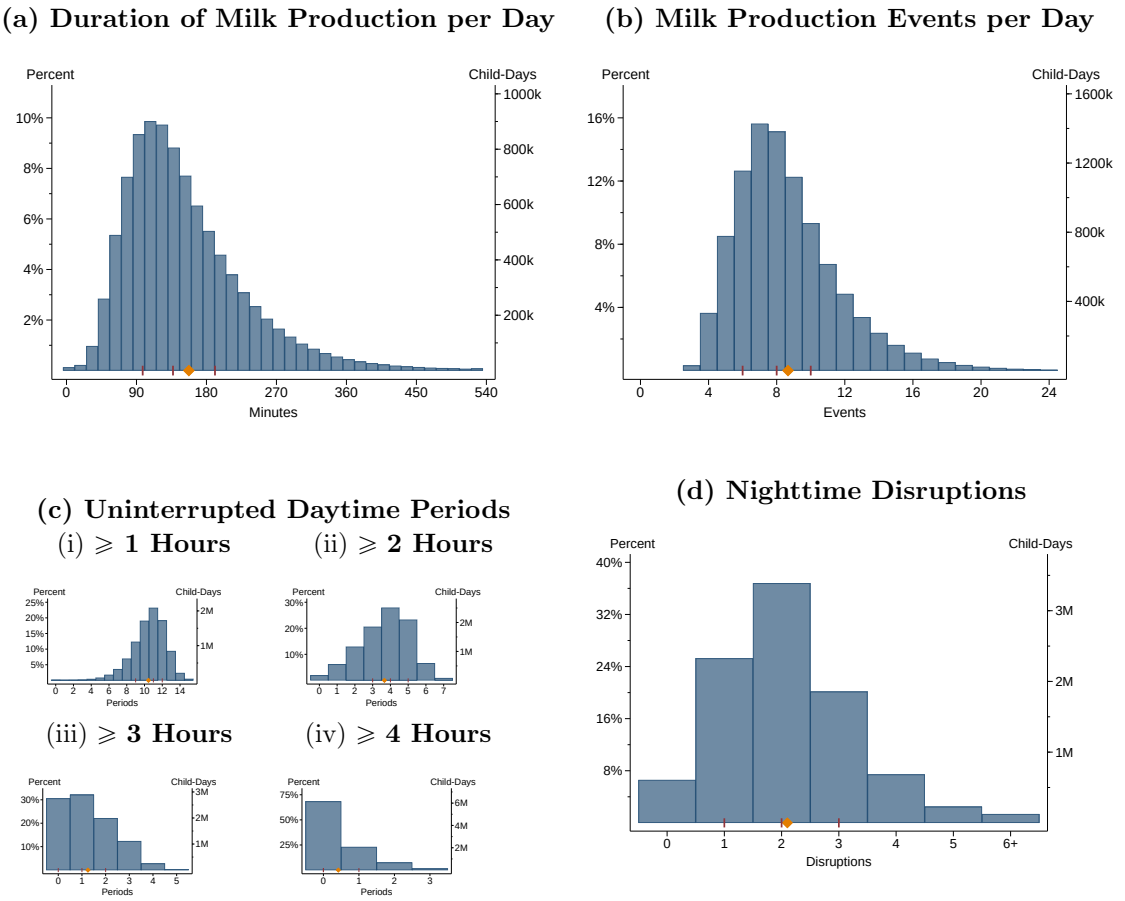


Figure 1: Milk Production

Notes. ◆ marks the mean, and | mark the 25th, 50th, and 75th percentiles. Day is defined as a 24-hour time window. Daytime is 06:00–22:00. Nighttime is 22:00–06:00. The sample spans infant ages 15–90 d. "k" in panels (a) and (b) refers to thousand (e.g., 700k = 700,000). "M" in panels (c) and (d) refers to million (e.g., 3M = 3,000,000). For clarity, durations > 540 minutes (panel a) and event counts > 24 (panel b) are excluded.

We begin by examining the time spent on milk production—direct nursing and pumped expression—during the infant's first 90 days (specifically, 15–90 days; see Supplementary Section B.1 for sample construction).

Figure 1a plots the distribution of total minutes spent on milk production per 24-hour period, based on 9,132,708 child-days. Mothers spend an average of 157 minutes producing milk (median = 137 minutes). The distribution is right-skewed: on 29% of child-days, mothers log more than three hours of milk production—equivalent to over half of a full-time work-week of 40 hours when aggregated to seven days.

We next consider how milk production shapes mothers' access to uninterrupted time during

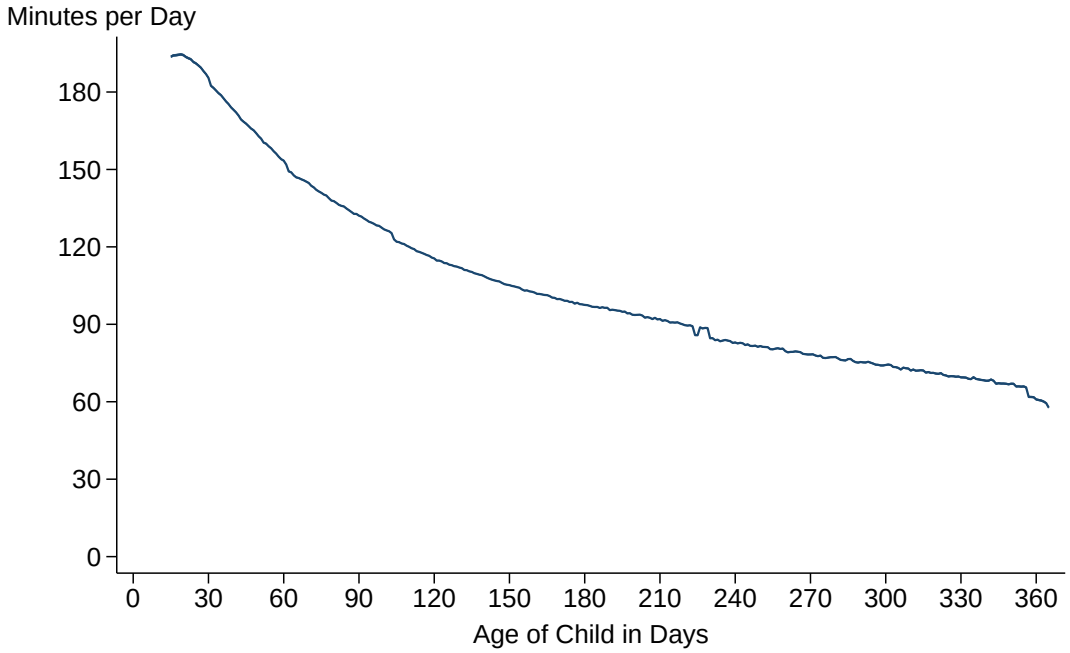
the day and night. Milk production fragments schedules in ways that may affect work, leisure and household activities. Regular, frequent milk removal is physiologically required—infants require frequent feeding, and clinical guidance stresses consistent emptying of the breasts to establish and maintain supply and to prevent milk stasis, engorgement, or mastitis [Centers for Disease Control and Prevention (CDC), 2025, La Leche League International, 2025, Kent et al., 2012, Berens et al., 2016, Amir and of Breastfeeding Medicine Protocol Committee, 2014].

Figure 1b depicts the distribution of milk-production events per child-day. Mothers log a mean of 9 distinct milk production sessions per 24 hours (median = 8 sessions). To quantify daytime fragmentation, we count—for each child-day—uninterrupted blocks of at least 1, 2, 3, and 4 hours between 06:00 and 22:00 (see Supplementary Section B.2 for details). Figure 1c shows that the median mother records several one- and two-hour windows, but only one uninterrupted three-hour period and zero four-hour periods per child-day. Consequently, the median mother lacks the uninterrupted stretches of time needed for extended work tasks or other activities that require sustained attention [Leroy, 2009].

Finally, we quantify time fragmentation at night. Figure 1d shows the number of milk-production events logged between 22:00 and 06:00 for each child-day. The median mother records two milk production-related interruptions per night, whereas those at the 95th percentile experience four or more production-related interruptions (excluding other causes). To the extent that these nocturnal interruptions fragment or shorten sleep, they may adversely affect maternal well-being and cognitive performance, as indicated by the broader sleep literature [Van Dongen et al., 2003, Dinges et al., 1997, Finan et al., 2015, Leong and Chee, 2023].

Milk Production Over the First Year While the preceding analysis focuses on the first 90 days after childbirth, many mothers continue producing milk for considerably longer. Clinical guidance has long emphasized exclusive breastfeeding for the first six months, followed by continued breastfeeding alongside complementary foods through the first year. Consistent with this, population-level data indicate that a substantial share of infants continue to receive breast milk well beyond the early postpartum period: in the United States, approximately 62% of infants born in 2022 are breastfed at six months and 41% at one year [Centers for Disease Control and Prevention, 2025a]. As infants' nutritional needs and feeding behaviors evolve, the time demands of milk

Figure 2: Relationship Between Child Age and Duration of Milk Production



Notes. The figure presents the estimates from a regression of daily milk production time on child age, controlling for child fixed effects. 95 % confidence intervals are shown, but are too narrow to be visually discernible at this scale.

production also change.

Figure 2 shows the estimated relationship between a child's age and the average daily time spent on milk production. We estimate this relationship with a regression that includes child fixed effects, so the curve reflects how feeding time changes for the same child as they age rather than differences across children. See Supplementary Section B.3 for details.

On day 15 of an infant's life, mothers spend an average of three hours per child-day producing milk. This duration declines with the child's age, averaging 1.8 hours in month five and 58 minutes by the end of the first year. This downward trajectory likely reflects several factors, including increased efficiency in milk removal, partial substitution of formula for breast milk in some infant–mother dyads, and the gradual introduction of solid foods.

We extend the analysis of first-year time use in Supplementary Section C in two ways. First, Figure C.1 reproduces the four panels of Figure 1 for the 91–180 and 181–365 day age bands. The patterns parallel those in Figure 2: as children grow older, the average duration and event counts for milk production fall, daytime fragmentation eases, and night-time disruptions become less frequent.

Second, we report results using a broader set of feeding-related activities (including bottle feeding and solids), rather than restricting attention to milk-production activities alone.

4 Economic Value of Milk Production Time

Figure 3: Duration and Economic Value of Milk Production in the First Year



Notes. ◆ marks the mean, and | mark the 25th, 50th, and 75th percentiles. Histogram of cumulative milk-production time and its value of time (VoT) for the first year. Each "mother" corresponds to an infant–mother pair aggregated over the first year of life. VoT is calculated at \$15.93/h—the 2020 U.S. median hourly wage of working women aged 25–34 (BLS, Table 8; U.S. Bureau of Labor Statistics [2021]). Axis ticks use "k" for thousand (e.g., 10k = 10,000).

As documented in Section 3, milk production requires substantial time. To make the value of this largely hidden contribution explicit—and to inform policies, workplace supports, and intra-household arrangements—we translate this time into dollars. Logged minutes are converted using a standard opportunity-cost, value-of-time (VoT) approach, which assigns each minute the wage the mother could have earned in paid work instead of producing milk [Becker, 1965].

We value the opportunity cost of this time, or shadow wage, using the 2020 U.S. median hourly pay for women aged 25–34 (\$15.93; U.S. Bureau of Labor Statistics, 2021), the demographic closest to our sample.

Because many mothers do not log every child-day for an entire year, we predict daily milk-

production minutes for missing child-days using the child fixed effects model introduced in Section 3. Throughout this section, "the first year" refers to days 15–365 postpartum, consistent with the sample construction described in Section 3. This procedure yields a complete daily series for each child-day throughout the first year. Multiplying these minutes by the shadow wage gives individual annual VoT estimates. Supplementary Section B.3 describes the prediction and imputation procedure, and Supplementary Section B.4 details the valuation assumptions. Supplementary Section D.2 reports robustness checks that (i) restrict the sample to fully recorded child-days and (ii) apply alternative wage benchmarks.

Figure 3 shows the model-based distribution of cumulative milk-production time for the first year and its economic value. The median mother generates a VoT of $9,386; the interquartile range spans $7,342–$12,354, and more than 5% of mothers exceed $19,524. These totals are likely conservative. In particular, milk-production sessions are scattered across the day and night rather than consolidated into a single block, and they are relatively inflexible, creating appreciable interference with work, leisure, and sleep (section 3). Jobs that demand such fragmented, round-the-clock commitments typically pay a scheduling premium—a margin not captured by the flat shadow wage used here.

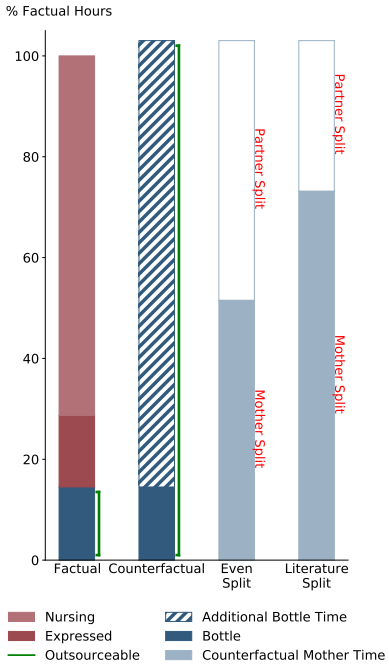
5 Counterfactual: Time Costs and Outsourcing Potential under Formula Feeding

Unlike nursing, bottle-feeding with infant formula can be shared with another caregiver. We therefore simulate a counterfactual in which all nursing and pumping stop and the infant is fed exclusively with formula.[2] Milk-production minutes fall to zero, and bottle-feeding minutes are replaced with the predicted feeding time implied by our conversion model. The predictions are based on a nursing–bottle conversion model that relates total feeding time to the bottle-feeding share (Supplementary Section B.5).

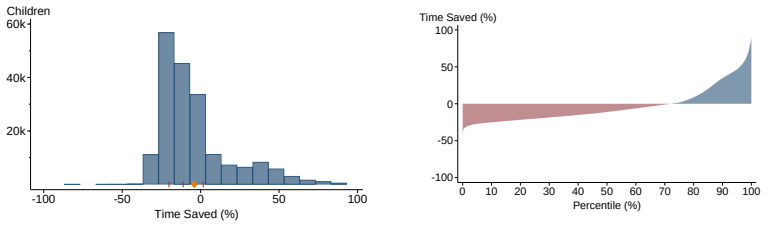
Figure 4a compares mothers' observed feeding-time allocation (left bar) with three counterfactual bars: an exclusive-formula counterfactual and two alternative redistributions of the now outsourceable bottle-feeding time. In the factual data, mothers spend 71% of feeding-related

[2] In the counterfactual we assume lactation ceases physiologically; expressed-milk minutes drop to zero.

(a) Counterfactual Conversion of Feeding Times to Fully Outsourceable Activities



(b) Distribution of Feeding Time Difference After Converting to Bottle Activities



(c) Distribution of Feeding Time Spent on Non-Outsourceable Milk Production

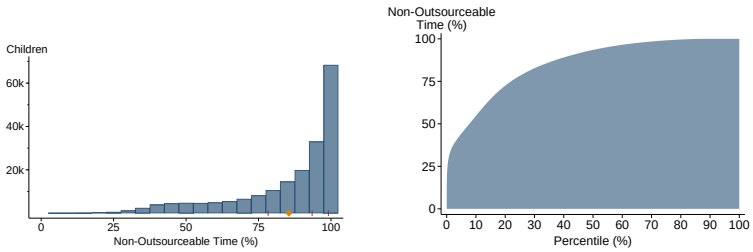


Figure 4: Time Adjustments From Switching to Formula Feeding

Notes. ◆ marks the mean, and | mark the 25th, 50th, and 75th percentiles. (a) Stacked bars compare mothers' observed allocation of feeding-related minutes across nursing, expressing and bottle-feeding ("Factual") with an exclusive formula counterfactual ("Counterfactual") and with two hypothetical redistributions of the now-outsourceable bottle minutes: a 50:50 and a 71:29 mother–partner split (71% ∼7.69/(7.69 + 3.17), where 7.69 and 3.17 denote mothers' and fathers' average weekly hours in basic child care; Guryan et al., 2008). (b) Time Saved Percent is calculated as 100 × (observed - counterfactual)/observed; values are bounded between –100% and 100% for display. A value of +100% means all feeding-related time would be eliminated, whereas –100% is an arbitrary lower bound—if counterfactual time more than doubles, the increase can exceed –100%. The left panel shows a histogram of time-saved percentages; the right panel orders the same values from lowest to highest (x-axis = percentile rank). (c) Non-Outsourceable Time (%) is the share of feeding-related time spent nursing or expressing under the milk-production regime; under exclusive formula this share would drop to zero. Axes in panels (b) and (c) use "k" for thousand (e.g., 60k = 60,000).

time nursing, 14% pumping (expressed), and 15% bottle-feeding. Under exclusive formula (second bar), total feeding-related time rises slightly to 103% of baseline, yet all of that time becomes outsourceable—whereas before, only 15% was (green bracket). Allocating the outsourceable minutes evenly between parents (third bar) or at a 71:29 mother–partner ratio (fourth bar, calibrated to mothers' versus fathers' weekly basic child care time shares in Guryan et al., 2008) reduces the mother's feeding-related time commitment to 52% and 73% of the baseline, respectively.

Figure 4b examines heterogeneity by ranking children according to the percentage of total feeding-related time their mothers would save if nursing and pumping were replaced by exclusive formula during the first year; potential savings from outsourcing are excluded. The median time saved is −11%, with an interquartile range of −20% to 2%. Negative values indicate that exclusive formula would increase the mother's feeding-related time. Two factors explain this dispersion. First, bottle-feeding is typically slower than nursing, though there is variation across mother–infant dyads. Second, mothers differ in the share of baseline time spent pumping: where that share is large, eliminating expression can offset some of the added bottle-feeding time. However, for most mothers, the additional time required for bottle-feeding outweighs any time savings from ending expression. As a result, the primary time-use benefit of formula feeding is not time savings, but the potential to reallocate feeding duties to other caregivers, reducing the mother's own time burden and increasing her scheduling flexibility.

Figure 4c shifts the focus to the share of feeding-related minutes that *cannot* be handed off under the observed milk-production regime—namely, nursing plus pumping. The left panel plots a histogram of this non-outsourceable share for every infant's mother; the right panel orders the same values by percentile. The median mother must currently perform 93% of all feeding-related minutes herself (i.e., this time is non-outsourceable under the milk production regime), with an interquartile range of 76%–99%. Switching to exclusive formula would eliminate this sizable share of non-outsourceable time. Combined with the modest—or even negative—time savings shown in Figure 4b, this pattern underscores that the chief advantage of formula feeding is redistributive: it converts a median 93% of all feeding-related minutes into time that can, in principle, be handed off to another caregiver.

6 Discussion

Milk production is a central and yet largely one-sided form of caregiving—performed almost exclusively by the birthing parent, often behind closed doors, and on a rigid schedule—yet its temporal implications have seldom been quantified. Using high-frequency, large-scale data on millions of milk production events, we empirically document how caregiving constraints arise not only from the amount of time required, but also from how that time is structured and who can perform it.

Specifically, we analyze approximately 203 million time-stamped nursing, pumping, and bottle-feeding events. During the first 90 days postpartum, mothers devote a mean of 157 minutes per child-day across approximately nine daily milk production sessions. The median mother has only one uninterrupted three-hour block and zero uninterrupted four-hour blocks during daytime, and experiences about two milk-production–related nighttime disruptions. Although daily minutes decline over the year, the cumulative commitment remains substantial—an estimated 39,621 minutes (about 660 hours, or 17 standard workweeks), with a median economic value of \$9,386 (interquartile range \$7,342–\$12,354). Replacing milk production with exclusive formula feeding seldom cuts total feeding-related time because bottle-feeding is often slower than nursing; its chief benefit is redistributive, converting a median 93% of non-outsourceable feeding-related minutes into time that can be shifted to other caregivers.

These estimates give policymakers, employers, and households a quantitative baseline for evidence-based decision-making and support-system design. In the first 90 days postpartum—the window many maternity-leave statutes aim to protect—a mother typically spends $2\frac{1}{2}$ hours on milk production per day. Even if a mother is on leave, the fixed commitment for milk production alone leaves little unbroken time for sleep or focus time. When the leave is unpaid or shorter than 90 days, there is a direct trade-off between the demands of milk production and earning an income. Over the full year, the median value of the time spent on milk production (\$9,386) falls within the same order of magnitude as the United Kingdom's flat-rate Statutory Maternity Pay and Canada's maternity benefit, but it exceeds the cash support available in the U.S. for mothers without paid leave [OECD, 2024].[3]

[3]These quantified opportunity costs complement evidence that long-duration breastfeeding is associated with larger and more persistent earnings penalties for mothers [Rippeyoung and Noonan, 2012], and that breastfeeding-promoting hospital regulations increase maternal child-care time while reducing formal-work hours in the first three months postpartum [Lawler and Yewell, 2023]. The time demands documented here may be one mechanism behind

At work, the cadence of milk production in the first 90 days leaves the median mother with no uninterrupted blocks longer than three hours. For knowledge workers in particular, the lack of multi-hour focus windows may limit the tasks they can undertake and could influence sorting toward roles and tasks that tolerate frequent interruption. Standard half-day work segments, extended meetings, or rigid shift rotations can therefore conflict with lactation needs. Offering short, protected pumping breaks every 2–3 hours—together with flexible scheduling or remote-work arrangements—can allow mothers to meet the physiological demands without having to withdraw from the labor force or incur wage penalties. Finally, the fact that milk production leaves the median mother solely responsible for roughly 93% of feeding-related time, and for about two milk-production disruptions each night, provides families with concrete parameters for deciding how partner leave, shared duties, or later feeding choices can be arranged to distribute early child-care evenly.

Our analysis opens new avenues for research on caregiving, time use, and female labor market integration. The minute-level granularity of these high-frequency logs captures dimensions of maternal labor that are invisible in datasets recording only whether and how long mothers breastfeed, while their self-initiated, in situ nature reduces observer effects. Linking such behavioral traces to surveys, health records, and administrative labor-market data would enable researchers to examine how institutional supports, household arrangements, and workplace practices shape caregiving behavior and its consequences over time. By making a pervasive but largely unseen form of labor measurable at scale, this approach lays the groundwork for evidence that can inform policies and practices aimed at sustaining maternal well-being, economic opportunity, and family life.

the "child penalty."

References

Abi Adams, Kotaro Hara, Kristy Milland, and Chris Callison-Burch. The gender wage gap in an online labor market: The cost of interruptions. *The Review of Economics and Statistics*, 107(1): 55–64, 01 2025. ISSN 0034-6535. doi: 10.1162/rest_a_01282. URL https://doi.org/10.1162/rest_a_01282.

Lisa H Amir and Academy of Breastfeeding Medicine Protocol Committee. Abm clinical protocol# 4: Mastitis, revised march 2014. *Breastfeeding Medicine*, 9(5):239–243, 2014.

Deborah J Anderson, Melissa Binder, and Kate Krause. The motherhood wage penalty: Which mothers pay it and why? *American economic review*, 92(2):354–358, 2002.

Christine Austin, Tanya M. Smith, Asa Bradman, Katie Hinde, Renaud Joannes-Boyau, David Bishop, Dominic J. Hare, Philip Doble, Brenda Eskenazi, and Manish Arora. Barium distributions in teeth reveal early-life dietary transitions in primates. *Nature*, 498(7453):216–219, 2013. doi: 10.1038/nature12169. URL https://pubmed.ncbi.nlm.nih.gov/23698370/.

Linda Babcock, Maria P Recalde, Lise Vesterlund, and Laurie Weingart. Gender differences in accepting and receiving requests for tasks with low promotability. *American Economic Review*, 107(3):714–747, 2017.

Baby Connect. Baby connect: Baby tracker for sleep, feeding, diapers, and more. https://en.babyconnect.com/. Accessed: 2025-06-13.

Michael Baker and Kevin Milligan. Maternal employment, breastfeeding, and health: Evidence from maternity leave mandates. *Journal of health economics*, 27(4):871–887, 2008.

Gary S Becker. A theory of the allocation of time. *The economic journal*, 75(299):493–517, 1965.

Pamela Berens, Wendy Brodribb, and Academy of Breastfeeding Medicine. Abm clinical protocol# 20: engorgement, revised 2016. *Breastfeeding Medicine*, 11(4):159–163, 2016.

Natalia V Bhattacharjee, Austin E Schumacher, Amirali Aali, Yohannes Habtegiorgis Abate, Rouzbeh Abbasgholizadeh, Mohammadreza Abbasian, Mohsen Abbasi-Kangevari, Hedayat Abbastabar, Samar Abd ElHafeez, Sherief Abd-Elsalam, et al. Global fertility in 204 countries

and territories, 1950–2021, with forecasts to 2100: a comprehensive demographic analysis for the global burden of disease study 2021. *The lancet*, 403(10440):2057–2099, 2024.

Lars Bode, Arjun S Raman, Simon H Murch, Nigel C Rollins, and Jeffrey I Gordon. Understanding the mother-breastmilk-infant "triad". *Science*, 367(6482):1070–1072, 2020.

Centers for Disease Control and Prevention. Breastfeeding Report Card, United States, 2022. Technical report, U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, Atlanta, GA, November 2023. URL https://www.cdc.gov/breastfeeding-data/breastfeeding-report-card/index.html. [Accessed June 11, 2025].

Centers for Disease Control and Prevention. Nis-child data results: Breastfeeding rates by birth year. https://www.cdc.gov/breastfeeding-data/survey/results.html, 2025a. Accessed: 2025-08; national breastfeeding percentages based on National Immunization Survey–Child, infants born in 2022.

Centers for Disease Control and Prevention. When, what, and how to introduce solid foods, 2025b. URL https://www.cdc.gov/infant-toddler-nutrition/foods-and-drinks/when-what-and-how-to-introduce-solid-foods.html. Accessed: 2025-04-09.

Centers for Disease Control and Prevention (CDC). How much and how often to breastfeed. https://www.cdc.gov/infant-toddler-nutrition/breastfeeding/how-much-and-how-often.html, March 2025. Accessed: 2025-06-19.

Silvia Cimino and Luca Cerniglia. Breastfeeding apps: A descriptive report. *Behavioral Sciences*, 13(10):801, 2023.

David F Dinges, Frances Pack, Katherine Williams, Kelly A Gillen, John W Powell, Geoffrey E Ott, Caitlin Aptowicz, and Allan I Pack. Cumulative sleepiness, mood disturbance, and psychomotor vigilance performance decrements during a week of sleep restricted to 4–5 hours per night. *Sleep*, 20(4):267–277, 1997.

Lauren M Dinour. Infant feeding tracker applications: cross-sectional analysis of use. *Journal of Nutrition Education and Behavior*, 54(9):835–843, 2022.

Paula England, Andrew Levine, and Emma Mishel. Progress toward gender equality in the united states has slowed or stalled. *Proceedings of the National Academy of Sciences*, 117(13):6990–6997, 2020.

Patrick H Finan, Phillip J Quartana, and Michael T Smith. The effects of sleep continuity disruption on positive mood and sleep architecture in healthy adults. *Sleep*, 38(11):1735–1742, 2015.

Emla Fitzsimons and Marcos Vera-Hernández. Breastfeeding and child development. *American Economic Journal: Applied Economics*, 14(3):329–366, 2022.

Norma I Gavin, Bradley N Gaynes, Kathleen N Lohr, Samantha Meltzer-Brody, Gerald Gartlehner, and Tammeka Swinson. Perinatal depression: a systematic review of prevalence and incidence. *Obstetrics & Gynecology*, 106(5 Part 1):1071–1083, 2005.

Claudia Goldin. The quiet revolution that transformed women's employment, education, and family. *American economic review*, 96(2):1–21, 2006.

Ariel Goldszmidt, John A List, Robert D Metcalfe, Ian Muir, V Kerry Smith, and Jenny Wang. The value of time in the united states: Estimates from nationwide natural field experiments. Technical report, National Bureau of Economic Research, 2020.

Jonathan Guryan, Erik Hurst, and Melissa Kearney. Parental education and parental time with children. *Journal of Economic perspectives*, 22(3):23–46, 2008.

Jonathan Heron, Thomas G O'Connor, Jonathan Evans, Jean Golding, Vivette Glover, ALSPAC Study Team, et al. The course of anxiety and depression through pregnancy and the postpartum in a community sample. *Journal of affective disorders*, 80(1):65–73, 2004.

Bernardo L Horta and Cesar G Victora. Long-term effects of breastfeeding. *Geneva: World Health Organization*, 74, 2013.

Renaud Joannes-Boyau, Joshua W. Adams, Christine Austin, Manish Arora, Ian Moffat, Andy I. R. Herries, Michael P. Tonge, Stefano Benazzi, Alistair R. Evans, Ottmar Kullmer, Stephen Wroe, Anthony Dosseto, and Luca Fiorenza. Elemental signatures of australopithecus africanus teeth reveal seasonal dietary stress. *Nature*, 572(7767):112–115, August 2019. doi: 10.1038/s41586-019-1370-5. URL https://www.nature.com/articles/s41586-019-1370-5.

Jacqueline C Kent, Danielle K Prime, and Catherine P Garbin. Principles for maintaining or increasing breast milk production. *Journal of Obstetric, Gynecologic & Neonatal Nursing*, 41(1): 114–121, 2012.

Henrik Kleven, Camille Landais, and Gabriel Leite-Mariante. The child penalty atlas. *Review of Economic Studies*, page rdae104, 2024.

La Leche League International. Newborn breastfeeding frequency – frequently asked questions. https://llli.org/breastfeeding-info/frequency-feeding-frequently-asked-questions-faqs/, June 2025. Accessed: 2025-06-19.

Emily C Lawler and Katherine G Yewell. The effect of hospital postpartum care regulations on breastfeeding and maternal time allocation. *American Economic Journal: Applied Economics*, 15(4):477–513, 2023.

Ruth LF Leong and Michael WL Chee. Understanding the need for sleep to improve cognition. *Annual review of psychology*, 74(1):27–57, 2023.

Sophie Leroy. Why is it so hard to do my work? the challenge of attention residue when switching between work tasks. *Organizational Behavior and Human Decision Processes*, 109(2):168–181, 2009.

Sarah E Mahoney, Sarah N Taylor, and Howard P Forman. No such thing as a free lunch: the direct marginal costs of breastfeeding. *Journal of Perinatology*, 43(5):678–682, 2023.

Joan Younger Meek, Lawrence Noble, and Section on Breastfeeding. Policy statement: Breastfeeding and the use of human milk. *Pediatrics*, 150(1):e2022057988, 06 2022. ISSN 0031-4005. doi: 10.1542/peds.2022-057988. URL https://doi.org/10.1542/peds.2022-057988.

National Academies of Sciences, Engineering, and Medicine. *Breastfeeding in the United States: Strategies to Support Families and Achieve National Goals*. National Academies Press, 2025. doi: 10.17226/29118.

OECD. Pf2.1: Parental leave systems. OECD Family Database, 2024. URL https://webfs.oecd.org/els-com/Family_Database/PF2_1_Parental_leave_systems.pdf. December 2024 update.

Emily Oster. *Expecting better: Why the conventional pregnancy wisdom is wrong–and what you really need to know*, volume 1. Penguin, 2013.

Emily Oster. *The family firm: A data-driven guide to better decision making in the early school years*, volume 3. Penguin, 2022.

Pew Research Center. Mobile fact sheet. https://www.pewresearch.org/internet/fact-sheet/mobile/, November 2024. Accessed: 2025-06-13.

Phyllis L. F. Rippeyoung and Mary C. Noonan. Is breastfeeding truly cost free? income consequences of breastfeeding for women. *American Sociological Review*, 77(2):244–267, 2012. doi: 10.1177/0003122411435477. URL https://doi.org/10.1177/0003122411435477.

Julie P Smith and Robert Forrester. Who pays for the health benefits of exclusive breastfeeding? an analysis of maternal time costs. *Journal of Human Lactation*, 29(4):547–555, 2013.

UNICEF and World Health Organization. Global Breastfeeding Scorecard 2024: Meeting the Global Target for Breastfeeding Requires Bold Commitments and Accelerated Action. Technical report, United Nations Children's Fund (UNICEF) and World Health Organization (WHO), New York, NY and Geneva, Switzerland, March 2025. URL https://knowledge.unicef.org/child-nutrition-and-development/resource/global-breastfeeding-scorecard-2024. [Accessed June 11, 2025].

U.S. Bureau of Labor Statistics. Women's earnings in 2020. Report, U.S. Bureau of Labor Statistics, 2021. URL https://www.bls.gov/opub/reports/womens-earnings/2020/.

Hans P.A. Van Dongen, Greg Maislin, Janet M. Mullington, and David F. Dinges. The cumulative cost of additional wakefulness: dose-response effects on neurobehavioral functions and sleep physiology from chronic sleep restriction and total sleep deprivation. *Sleep*, 26(2):117–126, Mar 2003. doi: 10.1093/sleep/26.2.117. Erratum in: Sleep. 2004 Jun 15;27(4):600.

Janne Van Kollenburg, Sander Bogers, Heleen Rutjes, Eva Deckers, Joep Frens, and Caroline Hummels. Exploring the value of parent tracked baby data in interactions with healthcare professionals: A data-enabled design exploration. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*, pages 1–12, 2018.

Cesar G Victora, Rajiv Bahl, Aluísio JD Barros, Giovanny VA França, Susan Horton, Julia Krasevec, Simon Murch, Mari Jeeva Sankar, Neff Walker, and Nigel C Rollins. Breastfeeding in the 21st century: epidemiology, mechanisms, and lifelong effect. *The lancet*, 387(10017):475–490, 2016.

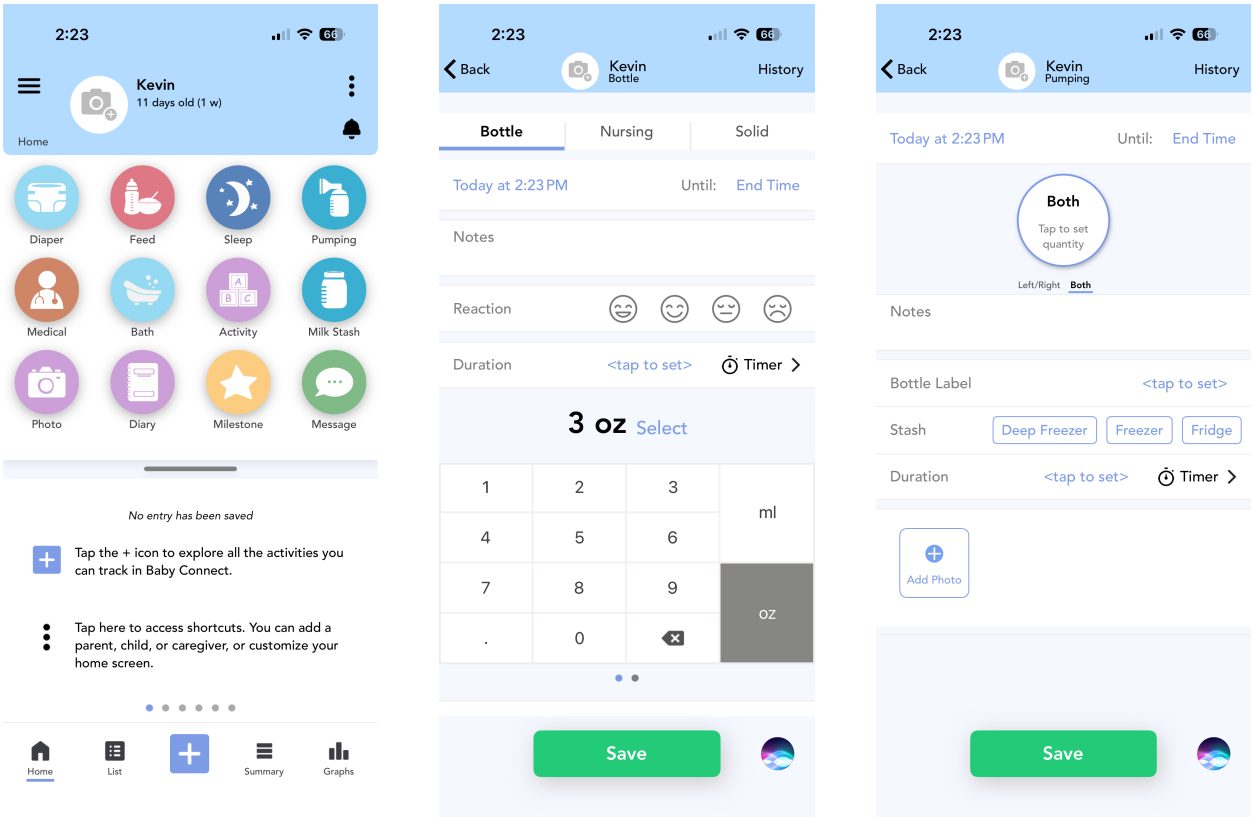
World Health Organization. Exclusive breastfeeding. https://www.who.int/tools/elena/interventions/exclusive-breastfeeding, 2024. Accessed: 2024-04-10.

World Health Organization. Breastfeeding – Questions and Answers. https://www.who.int/news-room/questions-and-answers/item/breastfeeding, 2025. [Accessed June 11, 2025].

Supplementary Information

A Baby Connect Mobile Phone Application

The data come from the mobile application BabyConnect, which allows parents to track various caregiving activities, including nursing, pumping, bottle-feeding, sleep, and developmental milestones. Each recording includes a start and end timestamp, along with activity-specific categorical data. Unique IDs identify each child and each parent account. To simplify our analysis, we focus exclusively on the child ID. This means that all results are at the child level and do not account for how multiple children may affect a parent's experience. Figure A.1 provides example screenshots from the BabyConnect interface, illustrating the activity categories and logging options available to users.



(a) Home screen with activity categories **(b) Feeding options (bottle, nursing, solids)** **(c) Pumping/expression screen**

Figure A.1: Screenshots from the BabyConnect application

Notes. These panels illustrate the interface of the BabyConnect app used for activity logging. (a) The main landing page presents the set of activity types that a user can record. (b) Selecting the *Feeding* icon opens options to log bottle feeding, nursing, or solid food intake. (c) The *Pumping* screen allows users to record milk expression sessions.

B Data Construction and Empirical Framework

B.1 Sample Construction and Data Restrictions

Figure B.1 presents the sequence of steps taken for sample construction. We describe each step in detail below.

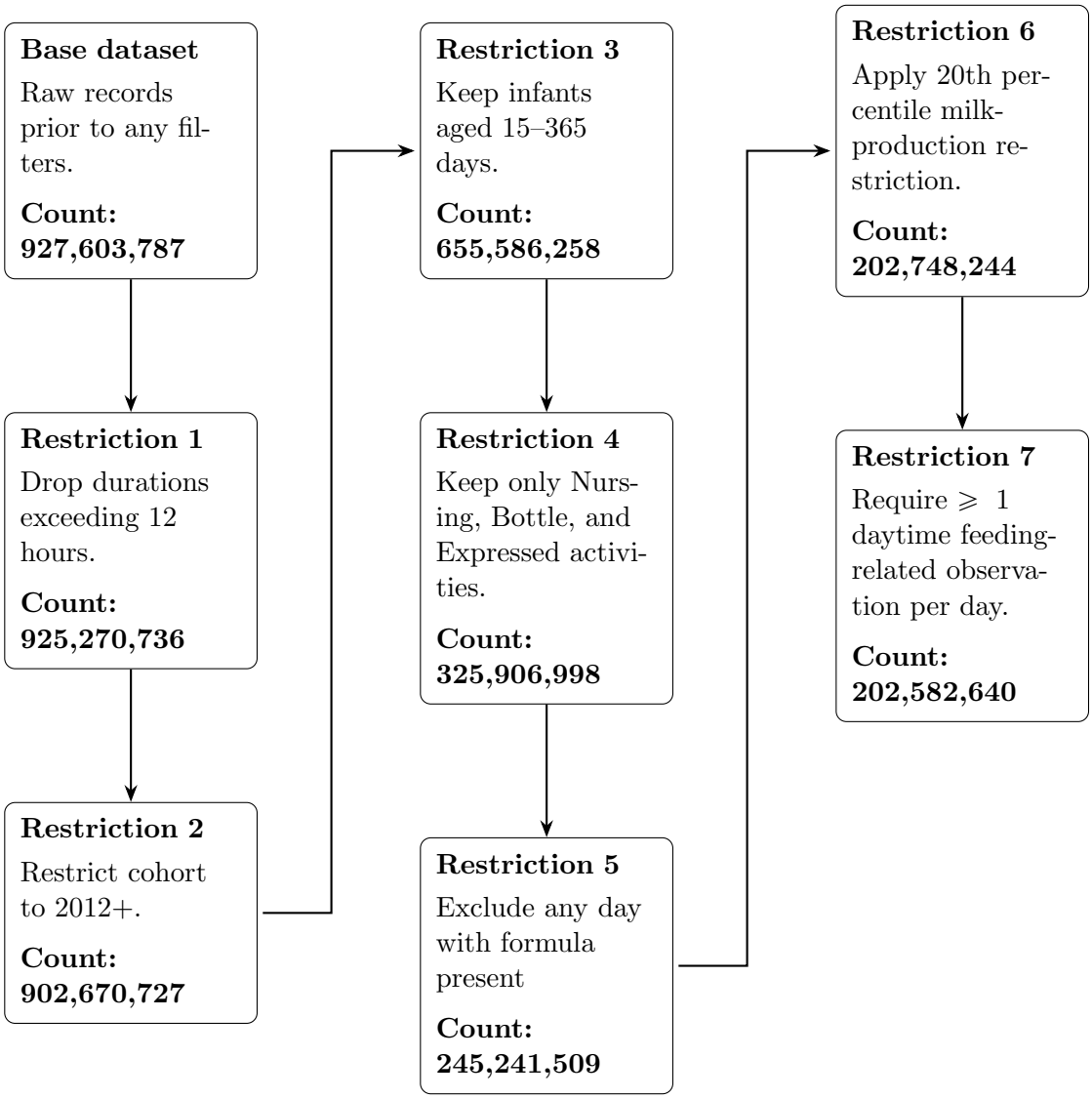


Figure B.1: Flow of dataset restrictions.

We start by removing any activities that have a reported duration of over 12 hours, as these likely reflect cases where users forgot to end tracking. We also exclude infants whose first recorded activity occurred prior to 2012, as only a small fraction of infants entered before this point, likely strongly selected (e.g., based on personal connection to the app creators). We further exclude the

first two weeks after childbirth due to inconsistent logging during that time of adjustment, and we limit the analysis to the first year of life as that reflects the most common period of usage.

From the full set of activities recorded in the app, we restrict attention to nursing, expression, and bottle feeding. To focus on milk production, we exclude child-days involving formula feeding, even for children who are primarily breastfed, as these days may not reflect typical feeding patterns.

To further ensure adequate daily recording, we exclude days in which an infant's total number of feeding events falls below the age-specific 20th percentile. These thresholds are calculated separately for each age (in days), and the filter is applied on a day-by-day basis—so an under-recorded day is removed even if other days for the same child are above the 20th-percentile threshold. We further require at least one feeding-related activity during daytime hours (08:00 - 20:00) to screen out days with incomplete logging.

Figure B.2 shows the age-specific 20th-percentile cutoffs, with excluded days highlighted in red. Applying these criteria produces an analytic dataset of approximately 203 million observations spanning two weeks to one year of age.

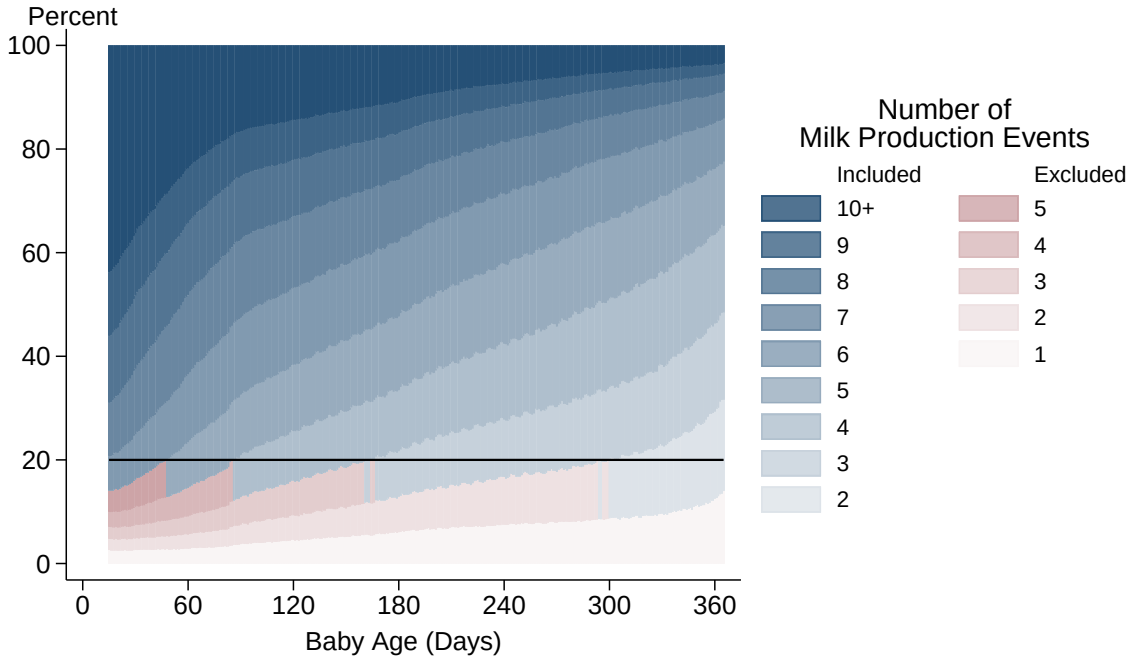


Figure B.2: Milk Production Activity Count Percentile Graph

Notes. The figure shows, for each infant age (in days), the percentile distribution of daily milk-production events. For a given age, each vertical slice represents the spread of event counts across all infants. The black line marks the 20th-percentile cutoff used for our sample restriction: days with event counts below this line are excluded (shown in red), and those above it are retained (shown in blue). For example, the median infant record at 15 days of age is nine milk-production events while the 20th percentile is six. The cutoff gradually declines with age, from about 5–6 events per day in early infancy to around 2 events per day later in the first year.

Between restriction steps (4) and (5) in Figure B.1, missing durations for focal activities (bottle-feeding, expression, or nursing) are imputed using linear regression after winsorizing durations at the 99th percentile. For expression and bottle-feeding events, the regression includes child age (in days) and its interaction with reported quantity (in milliliters). For nursing events, where quantity is not observed, the model includes child age alone.

After applying these restrictions, the dataset includes observations from 172 countries. Among observations with recorded country information, approximately 78 percent originate from the United States. Table B.1 reports summary statistics by country for infants aged 15–365 days. The United States accounts for more than half of the country-identified observations, while roughly one quarter of the full sample lacks country information. Differences in the recorded variables

across countries are modest. At the user level, the median user is associated with 1 infant and records 6 feedings per day.

Table B.1: Milk Production Statistics by Country

Country	*Duration per Day*	*Count per Day*	*Duration per Record*	*Average Age*	*ChildID Count*	*% of Observations*
US	120.89	6.99	18.43	32.37	112,828	57.4
CA	115.14	7.66	15.88	44.28	5,761	2.9
GB	125.90	8.11	16.33	41.43	4,300	1.9
AU	119.99	7.22	17.47	55.33	3,969	1.8
BR	126.32	7.18	18.53	39.04	2,775	1.3
FR	113.34	7.02	16.82	29.05	3,370	1.2
Other	117.34	7.47	16.72	44.92	16,646	7.5
Missing	123.84	7.08	18.52	45.88	101,316	26.1

Notes. Duration per Day and Count per Day is defined as the average duration (in minutes) and count of milk production events per child-day. Duration per Record is the average duration per recorded milk production event per child-day. Average age (in days) is at the child-level. ChildID count refers to the number of distinct ChildIDs recorded in that year. % of Observations corresponds to the fraction of total child-day observations in the respective year. We group all countries that account for less than 1% of total child-day observations under the label "Other".

Table B.2 evaluates trends in the data by year. We see minor changes in our sample composition over time, with a slight decrease in average age (in days) and in the milk production event count per day and a small increase in duration per record.

Table B.2: Milk Production Statistics by Year

Year	*Duration per Day*	*Count per Day*	*Duration per Record*	*Average Age*	*ChildID Count*	*% of Observations*
2012	129.53	7.54	17.90	42.15	20,920	4.7
2013	116.72	7.06	17.23	45.71	37,491	10.2
2014	119.17	7.15	17.44	41.44	41,612	11.5
2015	118.02	7.08	17.67	40.30	41,479	12.6
2016	121.71	7.18	18.01	35.20	36,144	11.1
2017	121.90	7.16	18.18	37.55	34,133	11.0
2018	122.49	7.04	18.64	38.04	30,619	10.1
2019	123.26	7.02	18.82	37.97	29,065	9.3
2020	126.12	7.15	19.01	35.58	28,479	9.6
2021	119.18	6.78	19.00	38.64	19,755	7.3
2022	121.52	6.87	19.16	35.67	8,274	2.7

Notes. Duration per Day and Count per Day is defined as the average duration (in minutes) and count of milk production events per child-day. Duration per Record is the average duration per recorded milk production event per child-day. Average age (in days) is at the child-level. ChildID count refers to the number of distinct ChildIDs recorded in that year. % of Observations corresponds to the fraction of total child-day observations in the respective year.

Figure B.3 presents a margins plot showing the model-predicted average number of daily milk

production events (nursing or expressing) as a function of infant age. The predictions reflect within-child changes over time, net of persistent differences across children. The figure serves as a diagnostic check on the age profile implied by the model and, in particular, helps assess data reliability at very early ages. At the youngest ages, predicted event counts are markedly lower than at slightly older ages, a pattern that likely reflects incomplete or delayed logging in the immediate postpartum period as users adopt the application. By the end of the first two weeks of life, predicted counts are consistently higher and the implied age profile closely aligns with descriptive evidence and clinical guidance: milk-production events decline smoothly as infants age, from approximately 9 events per day at one month, to 5.2 events at six months, and 2.6 events by one year. The narrow confidence intervals (not visually distinguishable at this scale) indicate that the estimated age gradient is precisely measured.

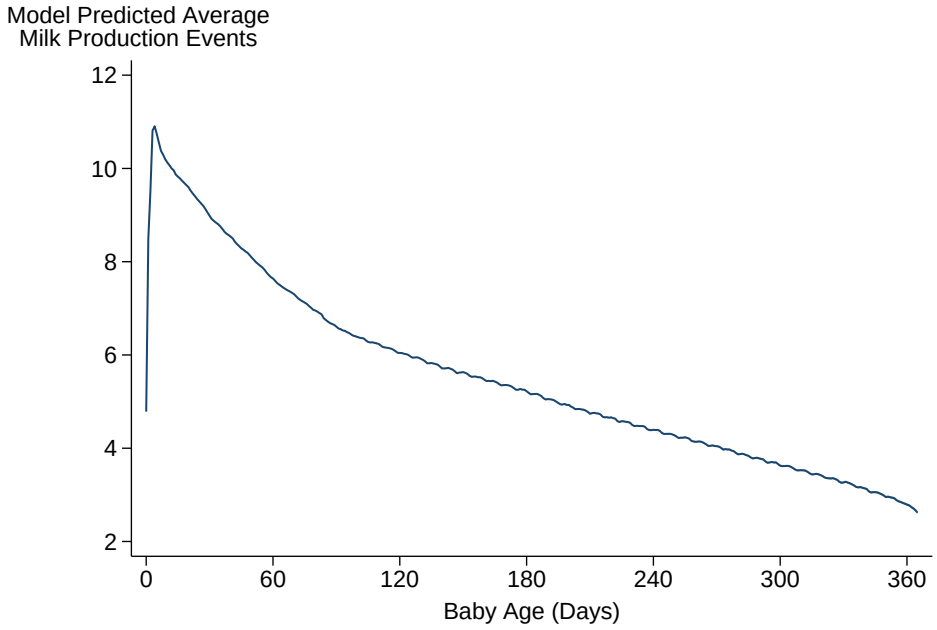


Figure B.3: Margins Plot for Milk Production Events

Notes. This figure plots the model-predicted average number of daily milk production events (nursing or expressed) by a baby's age in days, controlling for child-fixed effects. The vertical axis shows the predicted daily count and the horizontal axis tracks baby age from birth to 360 days. Shaded areas represent 95% confidence intervals around the predictions but are difficult to see due to their narrow range.

B.2 Construction of Daytime Uninterrupted Time and Nighttime Disruptions

The analyses of the shape of time demands, reported in Figures 1c and 1d, focuses on milk-production events—other activities are not considered. An uninterrupted period is defined as the interval between the end of one milk-production event and the start of the next. For each duration threshold (1+, 2+, 3+, or 4+ hours), we count the number of full, non-overlapping blocks of that length that can be placed within an uninterrupted period. For example, a 9 hour uninterrupted interval contributes nine 1+ hours, four 2+ hours, three 3+ hours, and two 4+ hours. Overlapping milk-production activities are merged into a single event, reflecting occasional inconsistencies in timestamp entry, and do not generate separate uninterrupted intervals.

Nighttime disruptions are defined as milk-production events that occur during nighttime hours, from 22:00–06:00 in the local time zone. When an uninterrupted interval spans the daytime-nighttime boundary, only the portion falling within daytime contributes to the daytime uninterrupted measure, and any portion occurring after 22:00 is counted as a nighttime disruption. For example, an uninterrupted period from 20:30 to 23:30 contributes 1.5 hours to daytime uninterrupted time, and the 22:00–23:30 segment is classified as a nighttime disruption.

Supplementary Section D.1 reports additional robustness checks for Figure 1, including sensitivity to redefining daytime as 08:00–20:00 rather than 06:00–22:00 (Figure D.1).

B.3 Milk Production Over the First Year

For Figures 2 and 3, the dataset is additionally restricted to observations with at least 30 days recorded per child to ensure reliable estimation. The following fixed-effects regression model is used to estimate the relationship between the child's age and milk production duration:

$$\log(\text{duration}_{it}) = \alpha_i + \sum_{d=15}^{365} \beta_d \times \mathbf{1}\{\text{age}_{it} = d\} + \varepsilon_{it}, \tag{1}$$

with i and t indexing the child and age in days. duration_{it} is the number of minutes that the mother of child i spent producing milk on day t, α_i captures child-specific fixed effects, and indicator variables represent each child's age in days. We generate model-based predicted values of milk-production duration for each child-day within the first year of life, using the estimated fixed effects and age-day coefficients. These predicted durations are aggregated at the child level across the first

year to obtain a model-based estimate of each child's cumulative milk-production time (a full year comprises 660 hours).

B.4 Valuation of Milk-Production Time

The economic value of mothers' time dedicated to milk production is computed using the 2020 U.S. median wage rate for women aged 25–34 of $15.93 per hour (see U.S. Bureau of Labor Statistics, 2021). Figure D.6 presents results using an alternative value-of-time estimate of $19.38 per hour [Goldszmidt et al., 2020]. Total predicted durations per child are multiplied by this wage rate to estimate the economic opportunity costs associated with breastfeeding duration.

B.5 Exclusive Formula Feeding Counterfactual

The counterfactual analyses estimating the conversion of time use between nursing and formula feeding, reported in Figures 4b and 4c, are estimated using a separate sample constructed specifically for this purpose. This conversion-rate sample follows the baseline data-cleaning procedures and cohort definitions described for the analytic sample in Section B.1. Specifically, both samples trim implausible event durations, restrict the cohort to children whose first recorded activity occurs in 2012 or later, and limit the analysis to observations between 15 and 365 days of age.

The conversion-estimation sample is designed to isolate child-days with reliably measured nursing and bottle-feeding durations. Accordingly, relative to the analytic sample, this estimation sample differs in several targeted respects.

First, the activity scope is restricted to nursing and bottle-feeding events only, excluding expression.[1] This reflects the fact that the conversion rate is defined on the nursing–bottle margin and does not involve expressed milk. As a result, the 20th-percentile activity restriction is applied based on nursing and bottle-feeding events (rather than milk-production events).

Second, child-days containing formula are retained when estimating the conversion rate, even though such days are excluded in the analytic sample. While formula use is excluded in the analytic sample to avoid distorting estimates of typical milk-production behavior, excluding these days during conversion estimation would remove feeding observations that are used to estimate the

[1] Missing nursing and bottle-feeding durations are imputed using age-based prediction models so that total daily feeding time can be constructed at the child-day level for estimation.

nursing–bottle relationship and is therefore not imposed.

Finally, the conversion-estimation sample does not impose the requirement that each child-day contain at least one daytime feeding-related observation. This requirement is used in the analytic sample to ensure that each child-day provides a reasonably complete representation of daily feeding activity within a standardized daytime window. In contrast, the conversion estimation exploits variation in the share of feeding time conducted via bottle across child-days and conditions on the number of feeding events, making complete daytime coverage unnecessary.

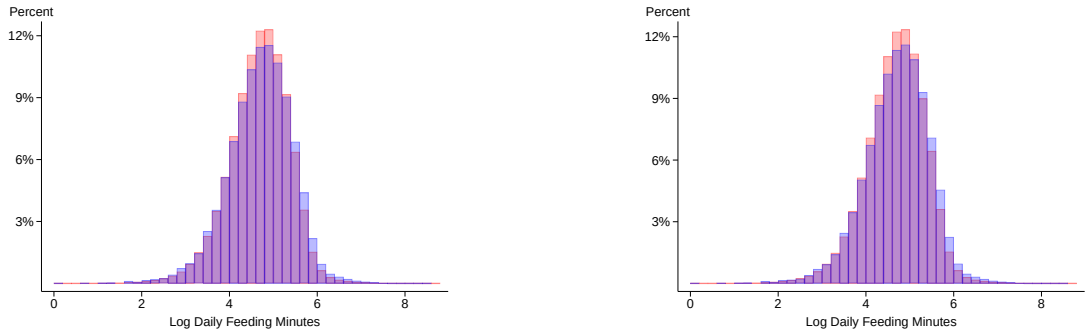
The conversion rate regression is given by

$$\begin{aligned}\log(\text{total_time}_{it}) = \beta_0 &+ \sum_w \gamma_w \cdot \text{age_weeks}_{iw} \times \text{share_bottle_time}_{it} + \sum_d \delta_d \cdot \text{dayofweek}_{id} \\ &+ \sum_d \lambda_d \cdot \text{day_within_ageweek}_{id} + \sum_{f,w} \theta_{fw} \cdot \text{total_feeding_events}_{if} \times \text{age_weeks}_{iw} \\ &+ \alpha_{it} + \epsilon_{it}\end{aligned}$$

with i and t indexing the child and age in days, respectively. $\log(\text{total_time}_{it})$ is the logarithm of total time spent feeding, age_weeks_{iw} is the child's age in weeks, $\text{share_bottle_time}_{it}$ is the proportion of feeding time spent using a bottle, dayofweek_{it} captures trends in the specific day of the week (e.g., Monday, Tuesday, etc.), $\text{day_within_ageweek}_{id}$ captures the day's position within an age week (e.g., first, second, etc.), $\text{total_feeding_events}_{if}$ is the total number of feeding events in a day, and α_{it} represents fixed effects for each child-week combination. Due to sparseness of observations above 20 event counts, we group all total feeding event counts of 20 or more into a single category in the regression.

The conversion rate equation captures the relationship between total feeding time and various factors, including infant age, bottle-feeding proportion, feeding frequency, and time-fixed effects. We use it to estimate total feeding time per child-day under a counterfactual scenario of exclusive formula (i.e., bottle)-feeding. To this end, we compute the difference between the model-predicted feeding time at the observed bottle share and the predicted feeding time under 100% bottle use. This difference gives the model-predicted change in feeding time. Because only a share of children in the analysis sample are used in the estimation (98% matched to at least one estimated child-week), child-week fixed effects are not available for unmatched observations; we set these to zero. Figure

B.4 compares actual feeding times with model-predicted actual times for both the full sample and the matched subset. Given that the distributions are nearly identical, we conduct the analysis using the full sample.



(a) Full Sample **(b) Matched Sample**

Figure B.4: Predicted vs Actual Log Feeding Times

Notes. Observed, Predicted. The left panel includes the entire sample, while the right panel includes only matched observations.

We then express counterfactual total feeding time as

$$\text{Counterfactual Time} = \text{Factual Time} + \widehat{\Delta\text{Time}} - \text{Factual Expressed Time}.$$

where Factual Time is the observed sum of nursing, expressing, and bottle-feeding time, and $\widehat{\Delta\text{Time}}$ is the model-predicted change under exclusive formula feeding. Expressed time is subtracted because expression is assumed to cease once nursing is discontinued.

C Extended Results for Figure 1

C.1 Full-Year Age-Cohort Extension

This section expands the main analysis to shed further light on how the shape of time demands of milk production changes over the course of the first year after infant birth. The duration of daily milk production may vary over time, as solid foods get introduced (generally recommended no earlier than 4 months of age [Centers for Disease Control and Prevention, 2025b]), as mother and infant become more efficient, and as some mothers re-enter the labor force.

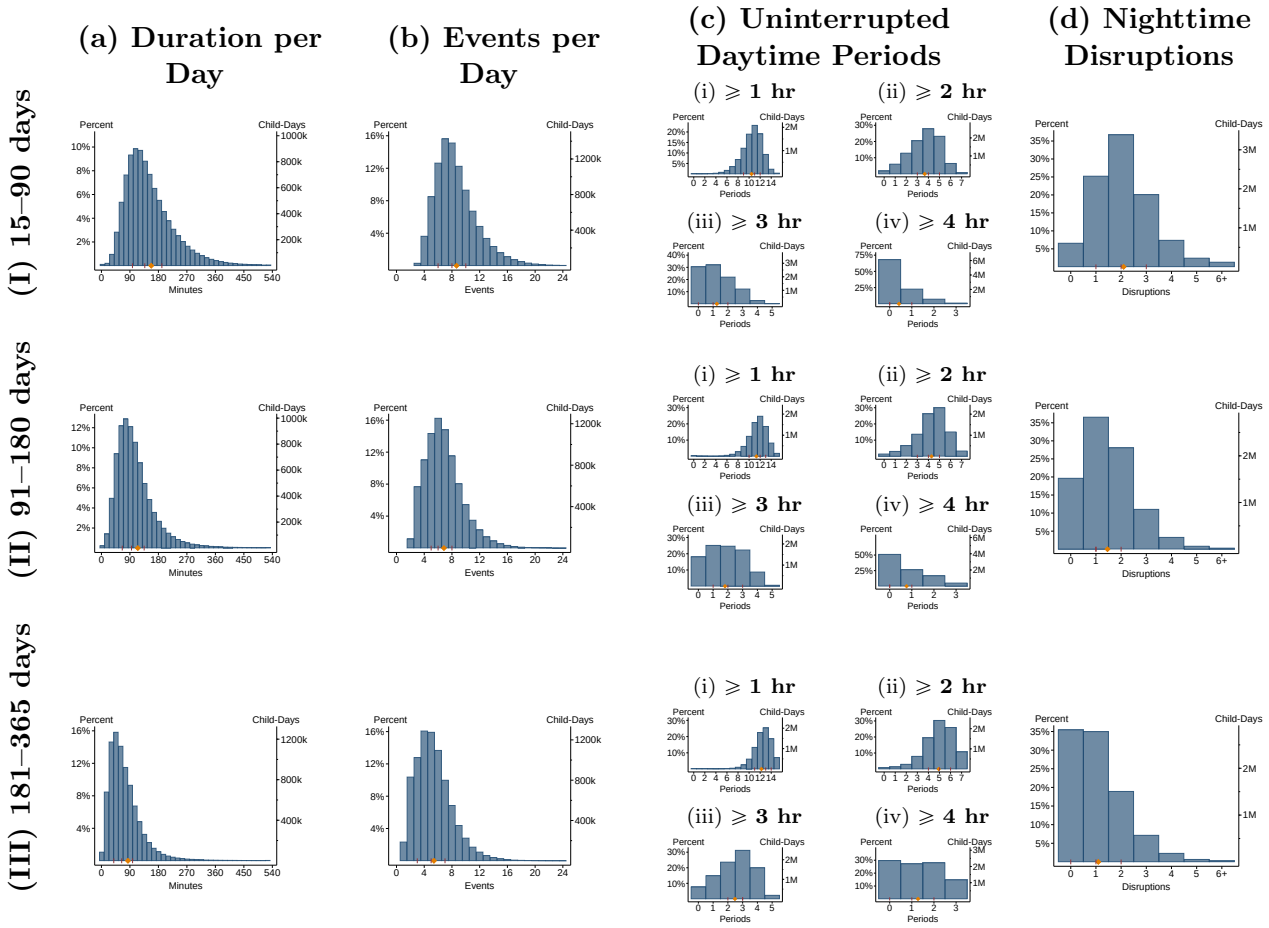


Figure C.1: Milk Production by Age Cohort

Notes. ◆ marks the mean, and | marks the 25th, 50th, and 75th percentiles. Daytime is 06:00–22:00; nighttime is 22:00–06:00. "k" in panels (a) and (b) refers to thousand (e.g., 700k = 700,000). "M" in panels (c) and (d) refers to million (e.g., 3M = 3,000,000). Durations > 540 minutes (panel a) and event counts > 24 (panel b) are excluded.

Figure C.1 examines trends in milk production across three age cohorts, namely 15-90 days (similar to the prior section), 91-180 days, and 181-360 days. We observe a steady decline in the duration of milk production activities as a child ages. The average daily duration of milk production differs meaningfully across these cohorts, with mothers of children aged 15–90 days spending 158 minutes per day compared to 115 minutes for the 91–180 day cohort and 85 minutes for the 181–365 day cohort (Figure D.4a). These differences are statistically significant (ANOVA, $F(2, 24{,}809{,}877) = 1{,}196{,}987$, $p < 0.001$), with mothers of 91–180-day-old infants spending 42 fewer minutes per day, and those of 181–365-day-olds spending 73 fewer minutes compared to the youngest cohort.

A similar pattern emerges when examining the frequency of daily milk production activities. As shown in Figure D.4b, the average number of events declines across age cohorts, from 8.7 among infants aged 15–90 days to 6.9 for those aged 91–180 days and 5.5 for those aged 181–365 days. This reduction is statistically significant (ANOVA, $F(2, 24{,}809{,}877) = 2{,}569{,}701$, $p < 0.001$), indicating a consistent decrease in milk production frequency as children age.

We also observe a substantial increase in the number of longer uninterrupted time periods during the day (Figure D.4c). For mothers of infants aged 15–90 days, the median number of daytime intervals lasting at least three hours is one; this figure triples to three for those aged 181–365 days. A similar increase is seen for four-hour intervals, rising from zero to one.

At night, we find a corresponding decline in interruptions linked to milk production (Figure D.4d). The median number of nighttime disruptions due to milk production activities falls by half—from two interruptions for mothers of children aged 15-90 days to just one for those with children aged 181-360 days. Additionally, uninterrupted nights become increasingly common, with the proportion of disruption-free nights rising from 7% to 20% and reaching 35% in the oldest cohort.

To ensure that these observed patterns are not driven by sample composition, we conduct a robustness check (see Supplementary Section D.1) using a restricted sample that includes only individuals present in all age cohorts. We find that the trends remain largely consistent, with only minor deviations that do not meaningfully affect the main conclusions.

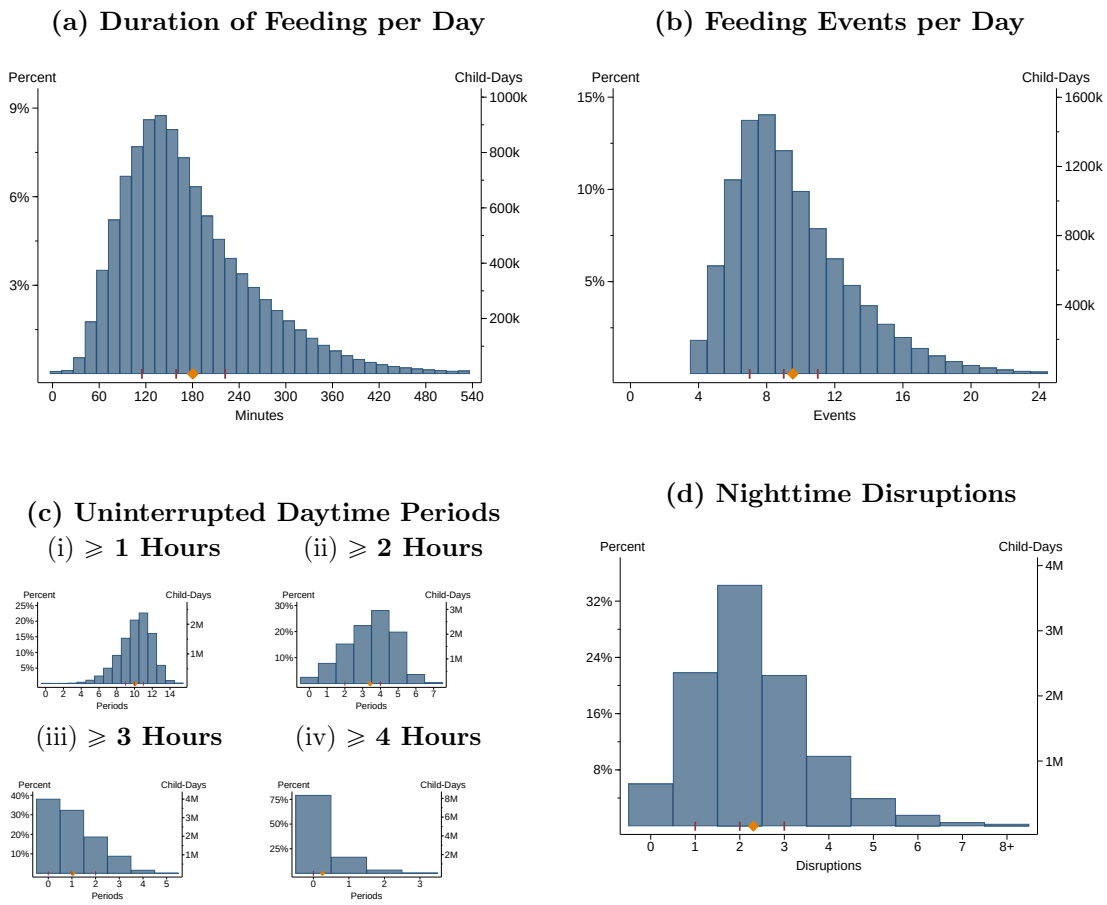


Figure C.2: Feeding Activities

Notes. ◆ denotes the mean, and | denotes the 25th, 50th, and 75th percentiles. Day is defined as a 24-hour day. Daytime is defined as being from 6am to 10pm. Nighttime is defined as being from 10pm to 6am. The age range of this sample is between 15 days and 84 days (12 weeks). "k" in panels (a) and (b) refers to thousand (e.g., 700k means 700,000). "M" in panels (c) and (d) refers to million (e.g., 3M means 3,000,000).

C.2 Extension to All Feeding-Related Activities

We extend the analysis in Figure 1 to *all* feeding-related activities—pumping, nursing, bottle-feeding and solid food feeding, to assess the broader feeding environment. These results appear in Figure C.2.

Daily feeding duration, event frequency, uninterrupted daytime intervals, and nighttime disruptions all exhibit the same qualitative structure observed when focusing solely on milk-production activities.

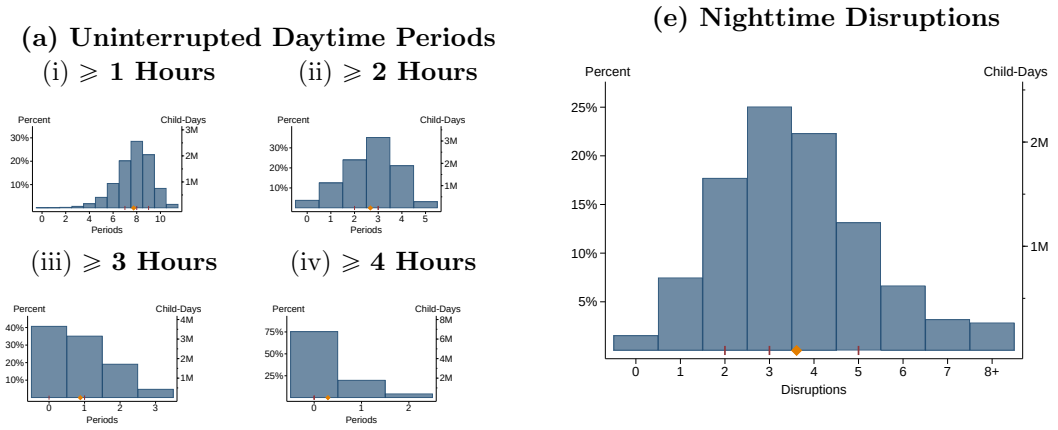


Figure D.1: Milk Production Using an Alternative Daytime Definition (08:00–20:00)

Notes. ◆ denotes the mean, and | denotes the 25th, 50th, and 75th percentiles. Day is defined as a 24-hour day. Daytime is defined as being from 8am to 8pm. Nighttime is defined as being from 8pm to 8am. The age range of this sample is between 15 days and 84 days (12 weeks). "k" in panels (a) and (b) refers to thousand (e.g., 700k means 700,000). "M" in panels (c) and (d) refers to million (e.g., 3M means 3,000,000).

D Robustness Checks

D.1 Figure 1 Robustness Check

This section evaluates the robustness of the patterns documented in Figure 1 and the extended results in Supplementary Section C.

First, we assess the sensitivity of the daytime- and nighttime-interval measures to an alternative definition of daytime (08:00–20:00 rather than 06:00–22:00). Because Figures 1a and 1b do not depend on the daytime cutoff, only the uninterrupted daytime intervals and nighttime disruptions are affected. As shown in Figure D.1, the patterns remain largely unchanged under the narrower daytime window, with the median mother having one uninterrupted daytime window of 3+ hours and three nighttime disruptions.

We also verify that the results are stable over time by splitting the sample into two periods, 2012–2017 and 2018–2022 (Figure D.2). Even though smartphone adoption moved from niche to near-universal over that period of time, the patterns we document are similar in both halves of the study window. This suggests that the main results are not affected by changes in the type of parent who selects into tracking milk production activities or by changes in smartphone or app usage.

Finally, we examine whether the age gradients in Figure C.1 reflect genuine within-child changes in the time demands of milk production as the child ages, or shifts in sample composition across

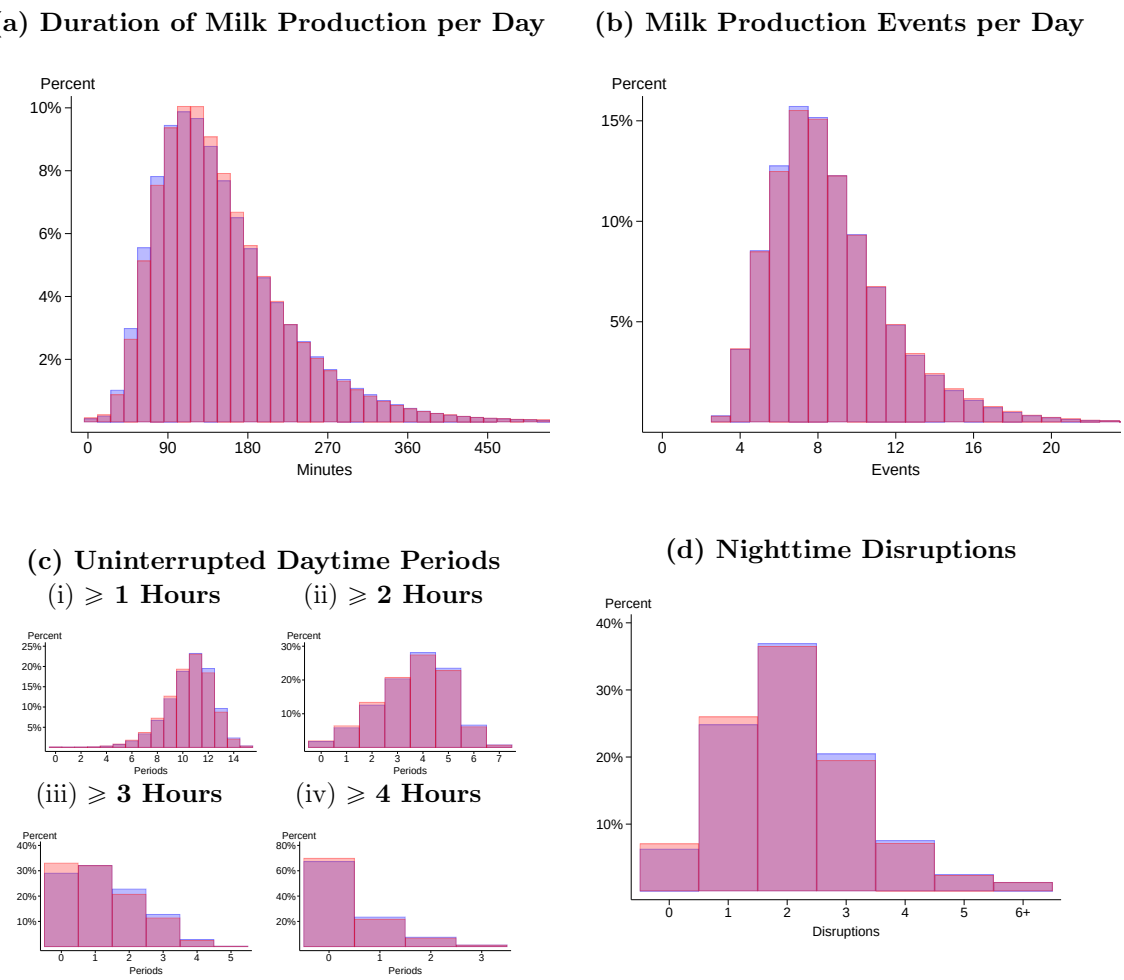


Figure D.2: Milk Production Across Two Periods

Notes. First half (2012–2017), Second half (2018–2022). ◆ marks the mean, and | mark the 25th, 50th, and 75th percentiles. Day is defined as a 24-hour time window. Daytime is 06:00–22:00. Nighttime is 22:00–06:00. The sample spans infant ages 15–90 d. "k" in panels (a) and (b) refers to thousand (e.g., 700k = 700,000). "M" in panels (c) and (d) refers to million (e.g., 3M = 3,000,000). For clarity, durations > 540 minutes (panel a) and event counts > 24 (panel b) are excluded.

age groups. While the figure shows clear differences across the 15–90, 91–180, and 181–365 day age cohorts, it does not distinguish between whether these patterns arise from aging or from possible changes in who appears in each cohort. Figure D.3 shows the fraction of children observed in each age-cohort combination.

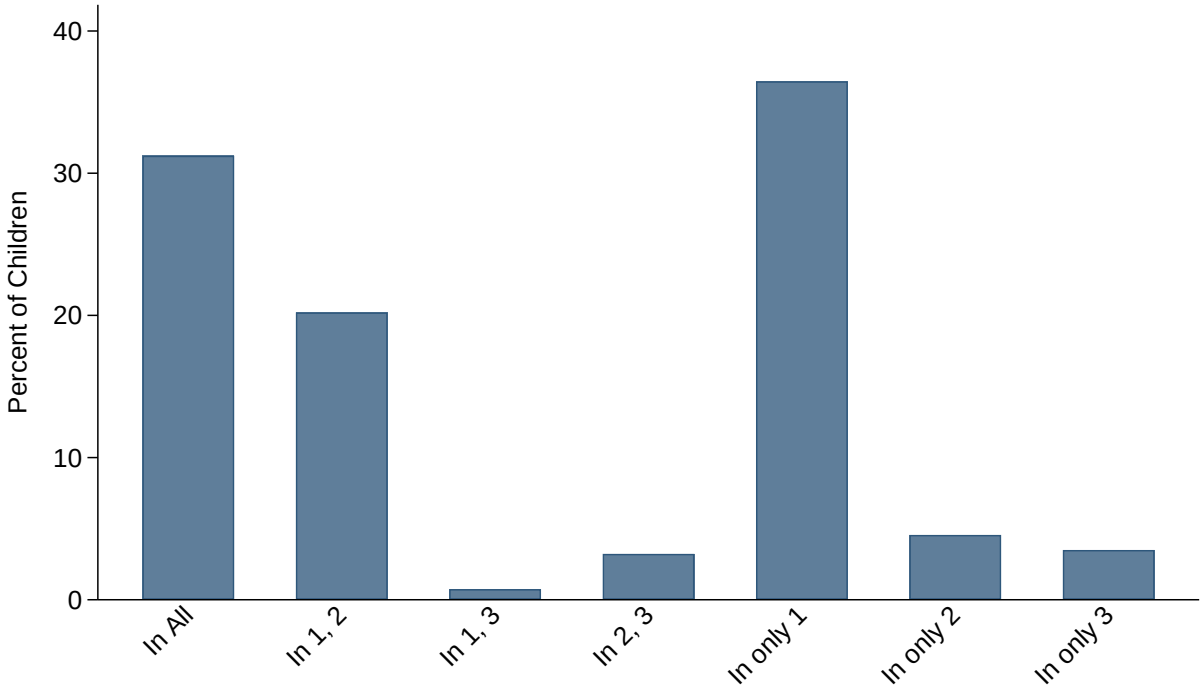


Figure D.3: Entry and Exit by Age Cohort

Notes. Notes: The vertical axis reports the percentage of all children in the sample who are observed in each age cohort or cohort combination, where cohorts correspond to ages 15–90, 91–180, and 181–365 days. Categories labeled "In only k" indicate children observed exclusively in age cohort k, while categories labeled "In i, j" indicate children observed in both age cohorts i and j. "In All" denotes children observed in all three age cohorts. Percentages sum to 100 across categories.

To gauge the influence of sample composition, we limit the analysis to children observed in all three age cohorts. Only 31% of children meet this criterion, whereas 37% appear exclusively in the youngest cohort, indicating substantial attrition as children age. This restriction substantially reduces the sample, but it enables us to focus purely on within-child patterns.

Figure D.4 shows that restricting the sample to children observed in all three cohorts yields patterns that closely parallel those in the full dataset (Figure C.1). The age gradients in daily milk production duration and event frequency (Figures D.4a–D.4b) are reproduced, with mean

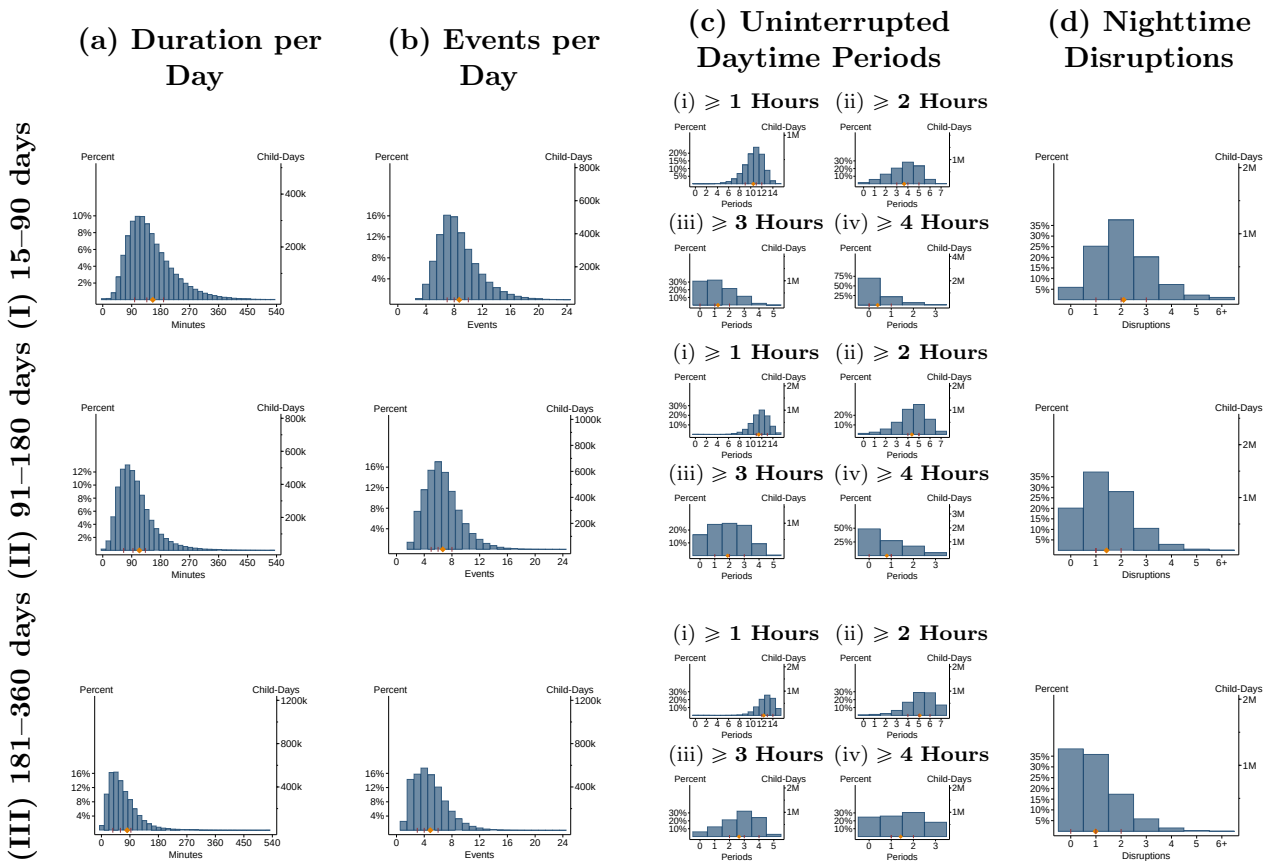


Figure D.4: Milk Production by Age Cohort Among Children Observed in All Three Cohorts

Notes. ◆ denotes the mean, and | denotes the 25th, 50th, and 75th percentiles. Daytime is 6am–10pm; nighttime is 10pm–6am. "k" in panels (a) and (b) refers to thousand. "M" in panels (c) and (d) refers to million.

levels that differ only modestly between the restricted and full samples. A similar result holds for uninterrupted daytime intervals (Figure D.4c) and nighttime disruptions (Figure D.4d), where we see the same qualitative decline in interruptions and increase in longer daytime intervals as children age.

While restricting attention to children observed in all three age cohorts isolates within-child patterns, it may modestly understate the true rate of decline if mothers exit the dataset after ceasing milk production, as their later (unobserved) values would effectively be zero.

D.2 Figure 3 Robustness Check

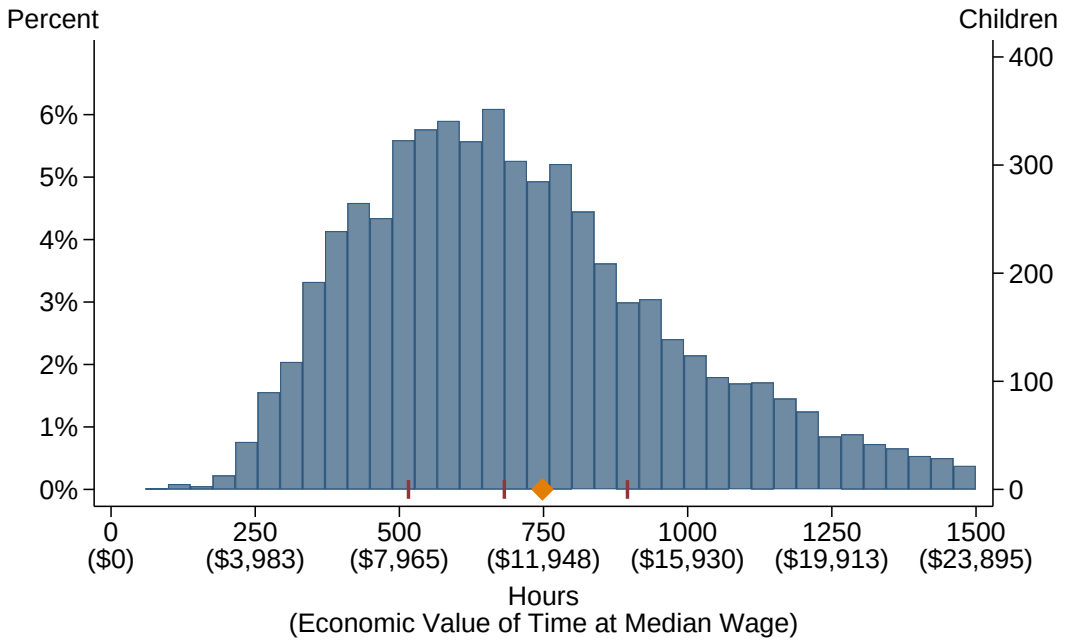
To evaluate whether incomplete recording affects our findings on the duration and economic value of milk production in the first year, we repeat the primary analyses, restricting the sample to children with a milk-production activity recorded every day from day 15 through day 365 (N = 5,777 vs. N = 192,147 in the full sample). Figure D.5 displays the results under this restriction. The observed patterns remain qualitatively similar, with the distribution shifted slightly upwards, indicating that the main conclusions are not driven by partial reporting.

We also assess the sensitivity of the economic value estimates to alternative wage rates. Specifically, we recalculate the economic value of mothers' time using a value-of-time benchmark of $19.38 per hour (2015 dollars) that has been estimated using large-scale natural field experiments in the U.S. [Goldszmidt et al., 2020]. This benchmark is estimated using revealed-preference evidence on how people trade off money and time in real-world decisions about ride hailing. Figure D.6 summarizes the results. While the absolute dollar values change, the relative patterns and main findings are robust to the choice of wage benchmark.

D.3 Figure 4 Robustness Check

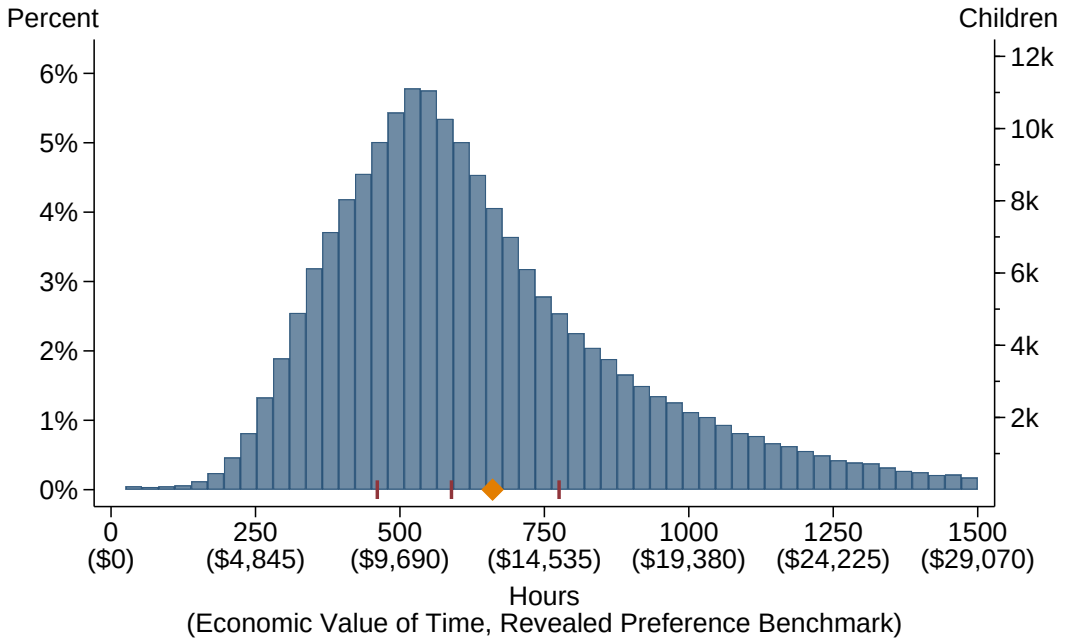
The results in the main text in the counterfactual of exclusive formula feeding consider the full first year. To assess whether the counterfactual effects differ earlier in infancy, we repeat the analysis for the first 90 days. Figure D.7 shows that the qualitative pattern of heterogeneous time savings persists over this earlier window. Relative to the full-year analysis, both the median and mean percent time saved are less negative (median -10% and mean -3.2%, compared with -11% and -4.1%), indicating a smaller increase in time spent early in infancy.

Figure D.5: Duration and Economic Value of Milk Production in the First Year Among Daily Recorders



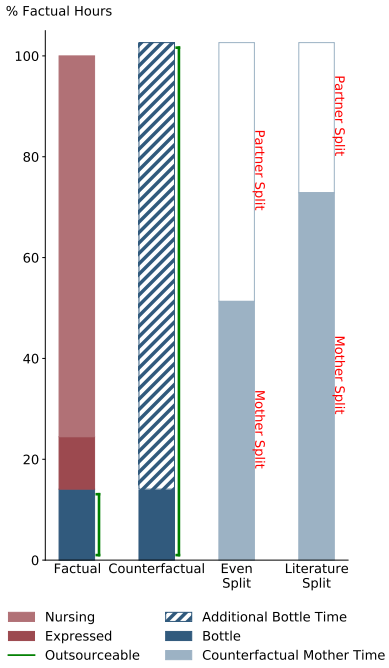
Notes. ◆ marks the mean, and | mark the 25th, 50th, and 75th percentiles. Histogram of cumulative milk-production time and its value of time (VoT) for the first year. VoT is calculated at \$15.93/h—the 2020 U.S. median hourly wage of working women aged 25–34 (BLS, Table 8; U.S. Bureau of Labor Statistics [2021]). Axis ticks use "k" for thousand (e.g., 10k = 10,000). Sample restricted to children with daily recording.

Figure D.6: Duration and Economic Value of Milk Production in the First Year Among Daily Recorders

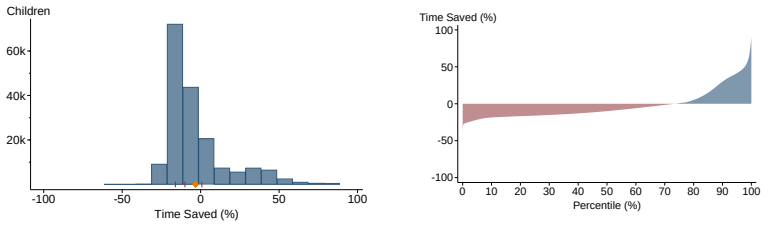


Notes. ◆ marks the mean, and | mark the 25th, 50th, and 75th percentiles. Histogram of cumulative milk-production time and its value of time (VoT) for the first year. VoT is calculated at \$19.38/h—a revealed-preference benchmark [Goldszmidt et al., 2020]. Axis ticks use "k" for thousand (e.g., 10k = 10,000).

(a) Counterfactual Conversion of Feeding Times to Fully Outsourceable Activities



(b) Distribution of Feeding Time Difference After Converting to Bottle Activities



(c) Distribution of Feeding Time Spent on Non-Outsourceable Milk Production

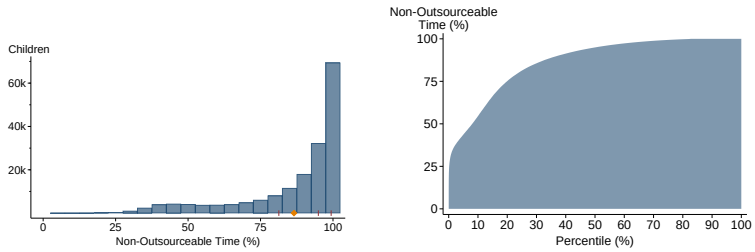
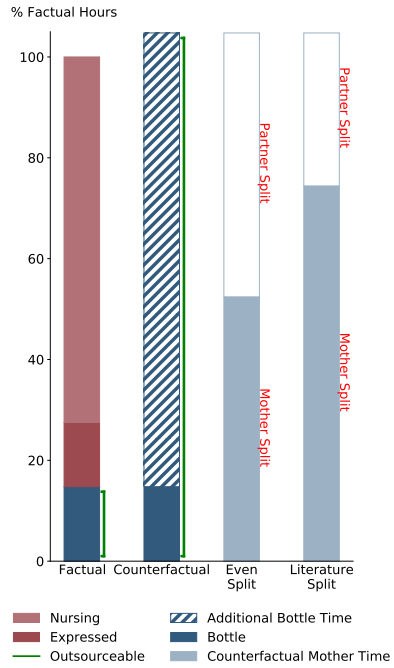


Figure D.7: Time Adjustments to Switching to Bottle Feeding During Days 15–90

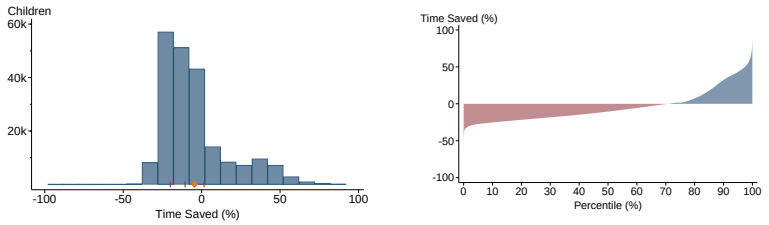
Notes. ◆ marks the mean, and | mark the 25th, 50th, and 75th percentiles. (a) Stacked bars compare mothers' observed allocation of feeding-related minutes across nursing, expressing and bottle-feeding ("Factual") with an exclusive formula counterfactual ("Counterfactual") and with two hypothetical redistributions of the now-outsourceable bottle minutes: a 50:50 and a 71:29 mother–partner split (71% ∼7.69/(7.69 + 3.17), where 7.69 and 3.17 denote mothers' and fathers' average weekly hours in basic child care; Guryan et al., 2008). (b) Time Saved Percent is calculated as 100 × (observed - counterfactual)/observed; values are bounded between –100% and 100% for display. A value of +100% means all feeding-related time would be eliminated, whereas –100% is an arbitrary lower bound—if counterfactual time more than doubles, the increase can exceed –100%. The left panel shows a histogram of time-saved percentages; the right panel orders the same values from lowest to highest (x-axis = percentile rank). (c) Non-Outsourceable Time (%) is the share of feeding-related time spent nursing or expressing under the milk-production regime; under exclusive formula this share would drop to zero. Axes in panels (b) and (c) use "k" for thousand (e.g., 60k = 60,000).

As a separate supplementary check, we replicate Figure 4 restricting the analytic sample to child-weeks that also enter the conversion-rate estimation. This restriction ensures that the results are not driven by differences in sample composition between the analytic and estimation datasets, and the corresponding patterns (Figure D.8) closely mirror the main analysis.

(a) Counterfactual Conversion of Feeding Times to Fully Outsourceable Activities



(b) Distribution of Feeding Time Difference After Converting to Bottle Activities



(c) Distribution of Feeding Time Spent on Non-Outsourceable Milk Production

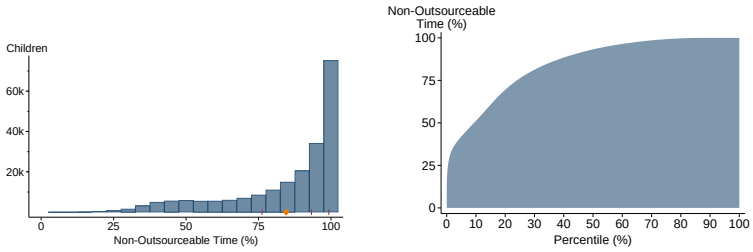


Figure D.8: Time Adjustments From Switching to Formula Feeding, Restricted Sample

Notes. ◆ marks the mean, and | mark the 25th, 50th, and 75th percentiles. (a) Stacked bars compare mothers' observed allocation of feeding-related minutes across nursing, expressing and bottle-feeding ("Factual") with an exclusive formula counterfactual ("Counterfactual") and with two hypothetical redistributions of the now-outsourceable bottle minutes: a 50:50 and a 71:29 mother–partner split (71% ∼7.69/(7.69 + 3.17), where 7.69 and 3.17 denote mothers' and fathers' average weekly hours in basic child care; Guryan et al., 2008). (b) Time Saved Percent is calculated as 100 × (observed - counterfactual)/observed; values are bounded between –100% and 100% for display. A value of +100% means all feeding-related time would be eliminated, whereas –100% is an arbitrary lower bound—if counterfactual time more than doubles, the increase can exceed –100%. The left panel shows a histogram of time-saved percentages; the right panel orders the same values from lowest to highest (x-axis = percentile rank). (c) Non-Outsourceable Time (%) is the share of feeding-related time spent nursing or expressing under the milk-production regime; under exclusive formula this share would drop to zero. Axes in panels (b) and (c) use "k" for thousand (e.g., 60k = 60,000). *This figure restricts the sample to child-weeks that appear in the conversion-rate estimation dataset shown in Fig. B.4b.*