Preplanned Studies

Reproductive Characteristics and Trends of Major Pregnancy Outcomes of Women at Different Parities — Beijing Municipality, China, 2013–2022

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Summary

What is already known about this topic?

With socioeconomic development, the increase of older pregnancies and multiparas has brought risks to mothers and infants.

What is added by this report?

As parities increased, the proportion of women of advanced maternal age (AMA) and non-local domicile increased, while the proportion of women with higher education levels decreased. Women with ≥3 parities are more likely to have preterm birth (PTB) and macrosomia.

What are the implications for public health practice?

A comprehensive analysis of pregnancy traits among women at different parities offers a robust foundation for tailored strategies against adverse pregnancy outcomes.

Studies have shown significant changes in the composition of the pregnant population and pregnancy outcomes over the past decade (*1*–*2*). With the rising number of older mothers and high-risk pregnancies, the incidences of birth defects, preterm birth (PTB), and low birth weight (LBW) have also increased. Higher parity is associated with a higher incidence of these adverse pregnancy outcomes. However, the overall understanding of the reproductive characteristics of women with different parities in Beijing Municipality, China, remains limited. Therefore, a thorough analysis of the characteristics and pregnancy outcomes of women with different parities in Beijing is particularly valuable to inform better healthcare services and decision-making. This study analyzed data from 1,963,445 women with a gestational week of delivery ≥28 weeks and permanent residence in Beijing who gave birth between January 1, 2013 and December 31, 2022. The results showed that as parity increased, the proportions of advanced maternal age (AMA) and non-local domicile increased, while those with higher education levels decreased. Women with ≥3 parities had a higher risk of PTB and macrosomia. Therefore, strengthening maternal healthcare for multiparous women, especially those who are AMA or non-local, is essential.

This study utilized data from birth medical certificates issued through the Beijing Maternal and Child Health Network Information System. This system is used by all midwifery institutions in Beijing to issue birth certificates, with the average annual number issued accounting for 99.5% of newborns from these institutions. Given that the hospital delivery rate in Beijing is 99.99%, the data accurately reflects the fertility status of women in Beijing (*3*). This study analyzed data from 1,963,445 women residing in Beijing who delivered at ≥28 weeks between January 1, 2013 and December 31, 2022. Women were grouped by parity: P1 (primipara, parity=1), P2 (multipara, parity=2), and P≥3 (multipara, parity≥3). Chi-square tests and analysis of variance (ANOVA) were used for data analysis, with the Bonferroni method applied for multiple comparisons using R software (version 3.6.1, R Foundation for Statistical Computing, Vienna, Austria). Joinpoint regression program (version 5.0.2, Statistical Research and Applications Branch, National Cancer Institute) analyzed the annual percentage change (APC) in the proportion of cesarean section (C-section), PTB, LBW, and macrosomia across parity groups. All statistical analyses used a two-sided test with a significance level of $P<0.05$. The study was approved by the Medical Ethics Committee of Beijing Obstetrics and Gynecology Hospital, Capital Medical University (Ethics Approval Numbers: 2020-KY-032-01; 2021-KY-054-01).

This study included 1,331,201 (67.8%) primiparous women and 632,244 (32.2%) multiparous women. Among multiparous women, 95.1% were P2, and

4.9% were P≥3. The average maternal age was 30.4 years, and 17.5% of women were of AMA (≥35 years).

Table 1 demonstrates that the proportion of AMA increases with parity: 9.7%, 33.3%, and 43.6% for P1, P2, and P≥3 groups, respectively. To further analyze reproductive characteristics and major pregnancy outcomes, the results were stratified by maternal age (<35 or ≥35 years). Among women younger than 35 years, the proportion with an undergraduate education was highest in the P1 and P2 groups (66.9% and 54.5%, respectively). Conversely, the P≥3 group was predominantly composed of women with a junior secondary or primary school education (44.8%). The proportion of women with non-local domicile increased with parity: 33.6%, 41.2%, and 74.5% for P1, P2, and P≥3 groups, respectively. Regarding occupation, the proportion of office workers/professional and technical personnel was highest in the P1 and P2 groups (53.8% and 43.7%, respectively), while the P≥3 group had the largest proportion of unemployed/freelance individuals (31.0%). Within the AMA stratum, the P1 and P2 groups also exhibited the highest proportion of women with undergraduate education. In the P≥3 group, the most common education level was undergraduate (36.9%), followed by junior secondary or primary school (34.2%). Similar to the younger age stratum, the proportion of women with non-local domicile increased with parity. The largest proportion of women in the AMA stratum were office workers/professional and technical personnel (54.3%, 55.7%, and 27.9% for P1, P2, and P≥3 groups, respectively). However, the proportion of unemployed/freelance individuals in the P≥3 group was also higher in this stratum (23.1%).

Among women younger than 35 years, the proportion of C-section births was lowest in the primiparous group (36.9%), followed by those with three or more prior deliveries (38.7%) and the second-time delivering group (42.0%) (Table 2). Newborn outcomes also varied by parity in this age group. The incidence of PTB was highest (8.0%) among women with three or more prior deliveries and lowest (5.4%) in the second-time delivering group. The incidence of LBW was highest in the primiparous group (4.7%) and lowest (3.1%) in the second-time delivering group. Macrosomia increased with parity, with rates of 6.7%, 7.8%, and 9.3% in the primiparous, second-time delivering, and three or more prior deliveries groups, respectively. Among women of AMA, the proportion of C-section decreased as parity increased. The highest proportions of PTB and LBW were observed in the primiparous group (10.5% and 8.6%, respectively), followed by the three or more prior deliveries group (9.8% and 5.3%) and the second-time delivering group (7.5% and 4.5%). The incidence of macrosomia was highest (9.6%) in the group with three or more prior deliveries.

Figure 1 displays the trends of major pregnancy outcomes over the past decade. Among women younger than 35 years, the C-section rate in the P1 group decreased from 43.2% in 2013 to 35.2% in 2015 ($APC_{2013–2015}$=−11.8%, P<0.05), then increased to 37.3% by 2022 ($APC_{2015–2022}$=2.0%, P<0.05). The P2 group showed a decline from 2013 to 2022 ($APC_{2013–2022}$=−1.9%, P<0.05), while the P≥3 group experienced an increase until 2020 ($APC_{2013–2020}$=4.6%, P<0.05), followed by a decrease ($APC_{2020–2022}$=−4.5%, P>0.05). Similar trends were observed in the AMA group. For women younger than 35 years, the incidence of PTB rose across all parity groups from 2013 to 2022 (P1: $APC_{2013–2015}$=9.4%, $APC_{2015–2022}$=2.1%; P2: $APC_{2013–2022}$=3.0%; P3: $APC_{2013–2022}$=7.0%; all P<0.05). In the AMA group, the incidence of PTB in the P1 group fluctuated between 9.2% and 11.1% ($APC_{2013–2016}$=7.1% and $APC_{2016–2022}$=−1.0%, both P>0.05), while in the P2 group, it increased from 6.4% in 2013 to 8.2% in 2022 ($APC_{2013–2022}$=2.8%, P<0.05). The incidence of PTB in the P≥3 group fluctuated between 7.9% and 10.0% ($APC_{2013–2022}$=2.0%, P>0.05). The incidence of LBW increased in the P1, P2, and P≥3 groups among women younger than 35 years over the past decade (P1: $APC_{2013–2022}$=4.3%; P2: $APC_{2013–2022}$=3.6%; P3: $APC_{2013–2022}$=7.0%; all P<0.05). In the AMA group, the incidence of LBW fluctuated across all parity groups (P1: $APC_{2013–2016}$=9.0%, P<0.05; $APC_{2016–2022}$=−0.1%, P>0.05; P2: $APC_{2013–2017}$=−0.4%, P>0.05; $APC_{2017–2022}$=4.2%, P<0.05; P≥3: $APC_{2013–2022}$=2.9%, P<0.05). The incidence of macrosomia in the P1 group decreased from 8.1% in 2013 to 4.4% in 2022 ($APC_{2013–2018}$=−5.0%, $APC_{2018–2022}$=−8.9%, both P<0.05). It also declined in the P2 group from 8.8% to 6.4% ($APC_{2013–2022}$=−3.9%, P<0.05). The P≥3 group initially saw an increase ($APC_{2013–2015}$=13.0%, P>0.05) followed by a decrease ($APC_{2015–2022}$=−6.6%, P<0.05). In the AMA group, the incidences of macrosomia decreased in all parity groups (P1: $APC_{2013–2022}$=−7.0%; P2: $APC_{2013–2022}$=−5.6%; P3: $APC_{2013–2022}$=−5.8%, all P<0.05).

TABLE 1. Comparison of basic characteristics of women of different parities in Beijing Municipality, 2013–2022.

Variables	Total	Primipara	Multipara		*P*
		Parity=1	Parity=2	Parity≥3	
Maternal age (M±SD)	30.4±4.3	29.3±4.0	32.7±4.2*	33.7±4.7*,†	<0.001
AMA (*n*, %)	342,670 (17.5)	128,790 (9.7)	200,473 (33.3)*	13,407 (43.6)*,†	<0.001
Maternal age<35 years	1,620,775	1,202,411	401,077	17,287	
Education level (*n*, %)					<0.001
Postgraduate	221,268 (14.9)	182,382 (16.8)	38,380 (9.8)*	506 (3.2)*,†	
Undergraduate	941,347 (63.2)	725,239 (66.9)	211,824 (54.5)*	4,284 (27.1)*,†	
Senior secondary school/Secondary vocational school	198,136 (13.3)	118,504 (10.9)	75,769 (19.5)*	3,863 (24.5)*,†	
Junior secondary school/Primary school	127,188 (8.5)	57,410 (5.3)	62,699 (16.1)*	7,079 (44.8)*,†	
Illiterate/semi-literate	525 (0.1)	233 (0.1)	231 (0.1)*	61 (0.4)*,†	
Domicile (*n*, %)					<0.001
Local	1,030,612 (64.1)	791,323 (66.4)	234,933 (58.8)*	4,356 (25.5)*,†	
Non-local	577,822 (35.9)	400,267 (33.6)	164,854 (41.2)*	12,701 (74.5)*,†	
Residence (*n*, %)					<0.001
Urban	647,874 (50.2)	498,890 (52.8)	143,489 (43.0)*	5,495 (43.5)*	
Suburban	538,899 (41.8)	377,111 (39.9)	155,598 (46.7)*	6,190 (49.1)*,†	
Rural	103,699 (8.0)	68,575 (7.3)	34,193 (10.3)*	931 (7.4)†	
Ethnicity (*n*, %)					<0.001
Han	1,523,386 (94.2)	1,128,320 (94.1)	378,691 (94.5)*	16,375 (95.7)*,†	
Others	93,643 (5.8)	71,052 (5.9)	21,848 (5.5)*	743 (4.3)*,†	
Occupation (*n*, %)					<0.001
Office worker/professional and technical personnel	824,732 (50.9)	646,506 (53.8)	175,242 (43.7)*	2,984 (17.3)*,†	
Commercial/service worker	239,170 (14.8)	165,452 (13.8)	70,598 (17.6)*	3,120 (18.1)*	
Agricultural workers	13,982 (0.9)	6,659 (0.5)	6,778 (1.7)*	545 (3.1)*,†	
Others	188,684 (11.6)	129,284 (10.7)	56,164 (14.0)*	3,236 (18.7)*,†	
Unemployed/freelance	183,248 (11.3)	107,163 (8.9)	70,723 (17.6)*	5,362 (31.0)*,†	
Student	6,567 (0.4)	5,949 (0.5)	602 (0.2)*	16 (0.1)*	
Unknown	164,392 (10.1)	141,398 (11.8)	20,970 (5.2)*	2,024 (11.7)†	
Maternal age ≥35 years (AMA)	342,670	128,790	200,473	13,407	
Education level (*n*, %)					<0.001
Postgraduate	65,383 (20.4)	25,035 (22.2)	39,205 (20.0)*	1,143 (9.2)*,†	
Undergraduate	185,565 (57.8)	72,268 (64.2)	108,699 (55.4)*	4,598 (36.9)*,†	
Senior secondary school/secondary vocational school	38,379 (11.9)	10,005 (8.9)	26,065 (13.3)*	2,309 (18.5)*,†	
Junior secondary school/primary school	31,487 (9.8)	5,245 (4.7)	21,974 (11.2)*	4,268 (34.2)*,†	
Illiterate/semi-literate	390 (0.1)	38 (0.0)	201 (0.1)*	151 (1.2)*,†	
Domicile (*n*, %)					<0.001
Local	240,603 (70.5)	92,794 (72.7)	142,277 (71.0)*	5,532 (41.6)*,†	
Non-local	100,534 (29.5)	34,816 (27.3)	57,962 (29.0)*	7,756 (58.4)*,†	
Residence (*n*, %)					<0.001
Urban	154,978 (60.3)	60,550 (68.2)	90,191 (56.5)*	4,237 (49.1)*,†	
Suburban	86,293 (33.5)	25,769 (29.0)	56,895 (35.6)*	3,629 (42.1)*,†	
Rural	15,897 (6.2)	2,492 (2.8)	12,645 (7.9)*	760 (8.8)*,†	

Continued

Variables	Total	Primipara	Multipara		*P*
		Parity=1	Parity=2	Parity≥3	
Ethnicity (*n*, %)					<0.001
Han	319,198 (93.6)	118,958 (93.1)	187,720 (93.8)*	12,520 (94.7)*,†	
Others	21,899 (6.4)	8,778 (6.9)	12,417 (6.2)*	704 (5.3)*,†	
Occupation (*n*, %)					<0.001
Office workers/professional and technical personnel	185,276 (54.1)	69,934 (54.3)	111,602 (55.7)*	3,740 (27.9)*,†	
Commercial/service workers	47,832 (14.0)	15,742 (12.2)	29,725 (14.8)*	2,365 (17.6)*,†	
Agricultural workers	5,344 (1.6)	560 (0.4)	4,301 (2.2)*	483 (3.6)*,†	
Others	41,957 (12.2)	14,600 (11.4)	24,901 (12.4)*	2,456 (18.3)*,†	
Unemployed/freelance	35,455 (10.3)	9,617 (7.5)	22,743 (11.3)*	3,095 (23.1)*,†	
Student	337 (0.1)	186 (0.1)	141 (0.1)*	10 (0.1)	
Unknown	26,469 (7.7)	18,151 (14.1)	7,060 (3.5)*	1,258 (9.4)*,†	

Abbreviation: AMA=advanced maternal age.
* Compared with Parity=1, *P*<0.05.
† Compared with Parity=2, *P*<0.05.

TABLE 2. Major pregnancy outcomes of different parities in Beijing Municipality, 2013–2022.

Variables	Total	Parity=1	Parity=2	Parity≥3	*P*
Maternal age <35 years					
Maternal	1,620,775	1,202,411	401,077	17,287	
Mode of delivery (*n*, %)					<0.001
Vaginal delivery	1,002,496 (61.9)	759,207 (63.1)	232,690 (58.0)*	10,599 (61.3)*,†	
Cesarean section	618,279 (38.1)	443,204 (36.9)	168,387 (42.0)*	6,688 (38.7)*,†	
Newbirth	1,644,231	1,221,934	404,748	17,549	
Preterm birth (*n*, %)	93,492 (5.7)	70,408 (5.8)	21,688 (5.4)*	1,396 (8.0)*,†	<0.001
Low birth weight (*n*, %)	71,031 (4.3)	57,558 (4.7)	12,721 (3.1)*	752 (4.3)*,†	<0.001
Macrosomia (*n*, %)	114,848 (7.0)	81,472 (6.7)	31,751 (7.8)*	1,625 (9.3)*,†	<0.001
Maternal age ≥35 years (AMA)					
Maternal	342,670	128,790	200,473	13,407	
Mode of delivery (*n*, %)					<0.001
Vaginal delivery	150,310 (43.9)	51,069 (39.7)	92,446 (46.1)*	6,795 (50.7)*,†	
Cesarean section	192,360 (56.1)	77,721 (60.3)	108,027 (53.9)*	6,612 (49.3)*,†	
Newbirth	350,485	134,145	202,728	13,612	
Preterm birth (*n*, %)	30,671 (8.8)	14,135 (10.5)	15,196 (7.5)*	1,340 (9.8)*,†	<0.001
Low birth weight (*n*, %)	21,373 (6.1)	11,485 (8.6)	9,164 (4.5)*	724 (5.3)*,†	<0.001
Macrosomia (*n*, %)	25,134 (7.2)	8,286 (6.2)	15,548 (7.7)*	1,300 (9.6)*,†	<0.001

Abbreviation: AMA=advanced maternal age.
* Compared with Parity=1, *P*<0.05.
† Compared with Parity=2, *P*<0.05.

DISCUSSION

This study analyzed delivery information from Beijing over a decade, revealing that the proportion of AMA mothers increased with parity. Concurrently, the proportion of women with undergraduate education levels decreased, while the proportion of women of non-local domicile increased. Among those with ≥3 parities, the proportions of non-local domicile, lower education levels, and unemployed/freelance status were relatively higher. Xu et al. found similar trends in a cross-sectional study in five provinces in China, noting

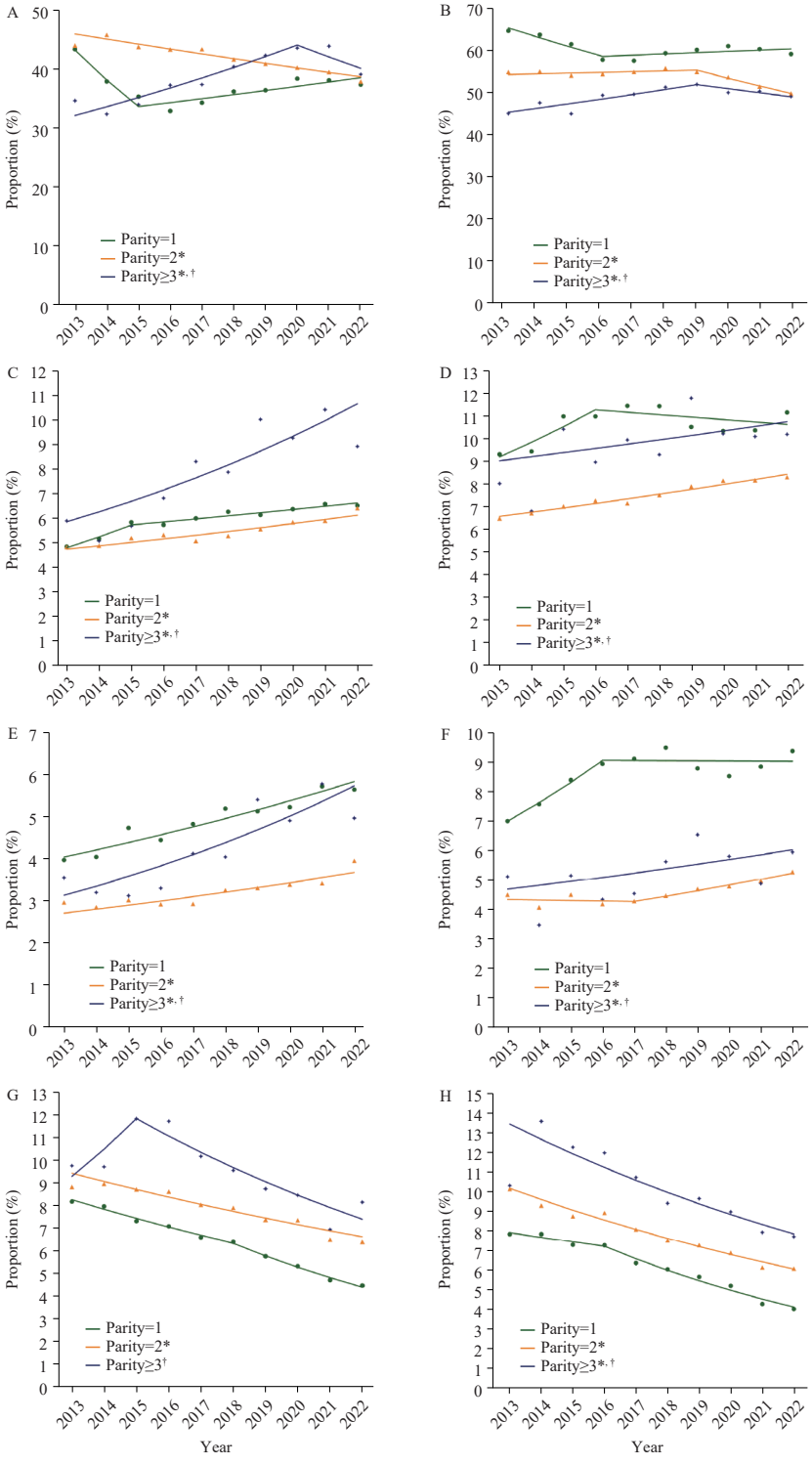

FIGURE 1. Trends of the proportion of C-section, PTB, LBW, and macrosomia among women of different parities in Beijing Municipality, 2013–2022. (A) The proportion of C-sections among maternal age <35 years; (B) The proportion of C-sections among maternal age ≥35 years; (C) The proportion of PTB among maternal age <35 years; (D) The proportion of PTB among maternal age ≥35 years; (E) The proportion of LBW among maternal age <35 years; (F) The proportion of LBW among maternal age ≥35 years; (G) The proportion of macrosomia among maternal age <35 years; (H) The proportion of macrosomia among maternal age ≥35 years.

Abbreviation: C-sections=cesarean section; PTB=preterm birth; LBW=low birth weight.

* Compared with Parity=1, $P<0.05$;

† Compared with Parity=2, $P<0.05$.

that women with low education and low income were more likely to have a second child (*3*). Studies in developed countries, such as in Europe, have also shown that highly educated women tend to have fewer children than those with lower education levels (*4*). Furthermore, women with high parities, believing themselves to be experienced in pregnancy and childbirth (*5*), tend to prioritize their own health less than primiparous women, potentially leading to pregnancy-related complications. This speculation is supported by neonatal outcomes, as the incidences of PTB and macrosomia were higher in the P≥3 group than in the P1 and P2 groups among younger women (maternal age <35 years). The mobility and economic conditions of non-local women further complicate access to perinatal care and elevate the risk of adverse pregnancy outcomes. An analysis of maternal mortality trends in Tianjin from 2011 to 2020 showed that, among maternal deaths, the proportion of women without stable occupations, those who were unemployed, and those with education levels below undergraduate were much higher than those with local domicile or higher education (*6*). These findings highlight challenges for maternal healthcare services in Beijing, emphasizing the crucial need for increased attention and targeted healthcare services for this demographic to improve birth outcomes.

Analysis of C-section births in Beijing over the past decade showed a decreasing trend followed by an increasing trend among primiparous women, regardless of maternal age. Unnecessary C-sections have adverse effects on both mothers and newborns; therefore, their use has been strictly controlled globally and nationally. According to data from 438 hospitals nationwide, the C-section rate among primiparous women decreased from 46.7% in 2013 to 37.9% in 2016 (*7*). In comparison, C-section use among primiparous women in Beijing has been lower than the national average. However, it rebounded after 2017, potentially due to delayed childbearing age. As maternal health declines and the incidence of gynecological diseases increases with age, the risk of C-section also increases. However, controlling C-section use remains a global challenge. C-section use in most countries and regions is currently rising, influenced by various factors such as family preferences, medical personnel skills, and healthcare payment models, making it difficult to control consistently with a single method (*8*).

Another concern is the rising trend of PTB incidence in Beijing, potentially attributable to rising maternal age or improved medical standards that allow preterm infants, especially early preterm infants, to survive (*9*). Notably, the incidence of macrosomia in Beijing has been effectively controlled, attributed to the promotion and continuous improvement of pregnancy nutrition clinics in Beijing (*10*). Pregnant women with high pre-pregnancy body mass index (BMI) or diagnosed with gestational diabetes mellitus (GDM) are recommended to receive professional dietary and exercise guidance in nutrition clinics, effectively controlling the incidence of macrosomia. However, the decline in macrosomia among multiparous women was not as rapid as among primiparous women, with the proportion in the P≥3 group consistently higher than the other two groups. Therefore, perinatal nutrition healthcare should be strengthened for women with high parities to reduce the incidence of macrosomia.

This study's strength is its exploration of characteristics in women with different parities using nearly all delivery information from Beijing between 2013 and 2022, providing a solid basis for developing targeted measures to control adverse pregnancy outcomes.

However, this study was subject to some limitations. First, it is solely based on data from Beijing and may not represent other provinces and cities. Second, the study lacks a comparison of high-risk factors. Future research should analyze and better understand the disease characteristics of women with different parities.

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