

1 **Epidemiological pattern of births from the largest surveillance database of live births in**
2 **Brazil "SINASC" before and during the COVID-19 pandemic in the Brazilian Amazon**

3
4
5 **Abstract**

6 The surveillance of live births in Brazil has been carried out since 1990 by the Information
7 System on Live Births (SINASC), which was implemented by the Ministry of Health aiming
8 at standardized registration on a national level. The state of Pará is part of the Brazilian
9 Amazon, northern Brazil, which has several unique characteristics. Thus, the purpose of this
10 study was to identify the epidemiological pattern of live births before and during the
11 pandemic of COVID-19 in the state of Pará, 2016 to 2020. This is an ecological
12 epidemiological time-series study, using epidemiological surveillance data from DATASUS,
13 referring to the Live Births Information System (SINASC). These are data that have been
14 treated by surveillance and are in aggregate format. The study population is the live births
15 residing in the state of Pará, in the period from 2016 to 2020. The data collection instrument
16 was the Declaration of Live Births (DLB). There were 689,454 live births, and the highest
17 rates of births were and continued to remain in the Marajó II, Baixo Amazonas, Xingu, and
18 Tapajós regions. The Metropolitan I and Araguaia regions were and continue to be the lowest
19 rates in the state. Age of the mother 15 to 19 years old 22.29%, 20 to 24 years old 30.05% and
20 25 to 29 years old 22.58%, most of the single pregnancy type 98.32%, prenatal consultations,
21 performed 7 or more 48.10%, followed by 4 to 6 consultations 33.98%, most presented 7 or
22 more years of the study 48.10%, followed by 3 to 6 years 33.98%. Represented 51.21% male
23 and 48.77% female. The occurrence of congenital anomalies represented 0.52% of live births.
24 Another congenital malformation and deformity were the most prevalent at 25.53%, followed
25 by Congenital deformities of the feet 14.90%, Other congenital malformations of the nervous
26 system 14.84%, and Other congenital malformations 10.77%, Cleft lip, and cleft palate

27 8.88%, Other congenital malformations digestive tract 8.10%. The demographic transition has
28 already occurred for several decades, including the reduction of fertility and birth rate, so our
29 study showed that the reduction in the number of live births was already a reality in the
30 country, but we emphasize that this reduction was enhanced by the pandemic. We observed
31 greater adherence to prenatal care and a lower prevalence of low birth weight compared to
32 other studies, but the limitation was the absence of studies in the same place of the research.
33 Regarding data incompleteness, we emphasize the ignored fields that reflect the fragility in
34 the surveillance of live births, which was reinforced by the literature.

35 **Keywords:** Epidemiology; Health Surveillance; Health Indicators; SINASC; Live Births;
36 COVID-19.

37 **INTRODUCTION**

38 Surveillance of live births in Brazil has been carried out since 1990 by the
39 Information System on Live Births (SINASC), which was implemented by the Ministry of
40 Health aiming at a standardized national registry of information on live births. SINASC uses
41 the Declaration of Live Births (DLB) as an instrument for data collection, which has several
42 variables on the mother, prenatal care, delivery, and the newborn. This surveillance system
43 represents an essential source of information for health research and evaluation in the
44 maternal and child area [1].

45 Thus, SINASC surveillance subsidizes public health measures concerning women's
46 and children's health, such as public policies to reduce maternal mortality, and adherence to
47 quality prenatal, delivery, and puerperium care. The DLB is mandatory to be issued in three
48 copies, which will be a requirement for the birth certificate, which is a fundamental document
49 for the child's social, educational, and economic policies regarding society. [2].

50 Thus, the epidemiological pattern of live births has been studied for several years,
51 because profile changes must be identified for the development of strategies and

52 understanding of associated factors. Authors have discussed the demographic transition,
53 which highlights the reduction in fertility and birth rate, which has been occurring for decades
54 in the world and Brazil [3].

55 The state of Pará is part of the Brazilian Amazon, northern Brazil, which has several
56 unique characteristics, such as extensive geographical territory, compared to several European
57 countries together, as well as being composed of rural areas larger than urban areas, which
58 hinders access to education, health services, and health surveillance, indigenous peoples,
59 illegal mining, mercury contamination, factors that directly impact the health of the
60 population, making them vulnerable [4–6].

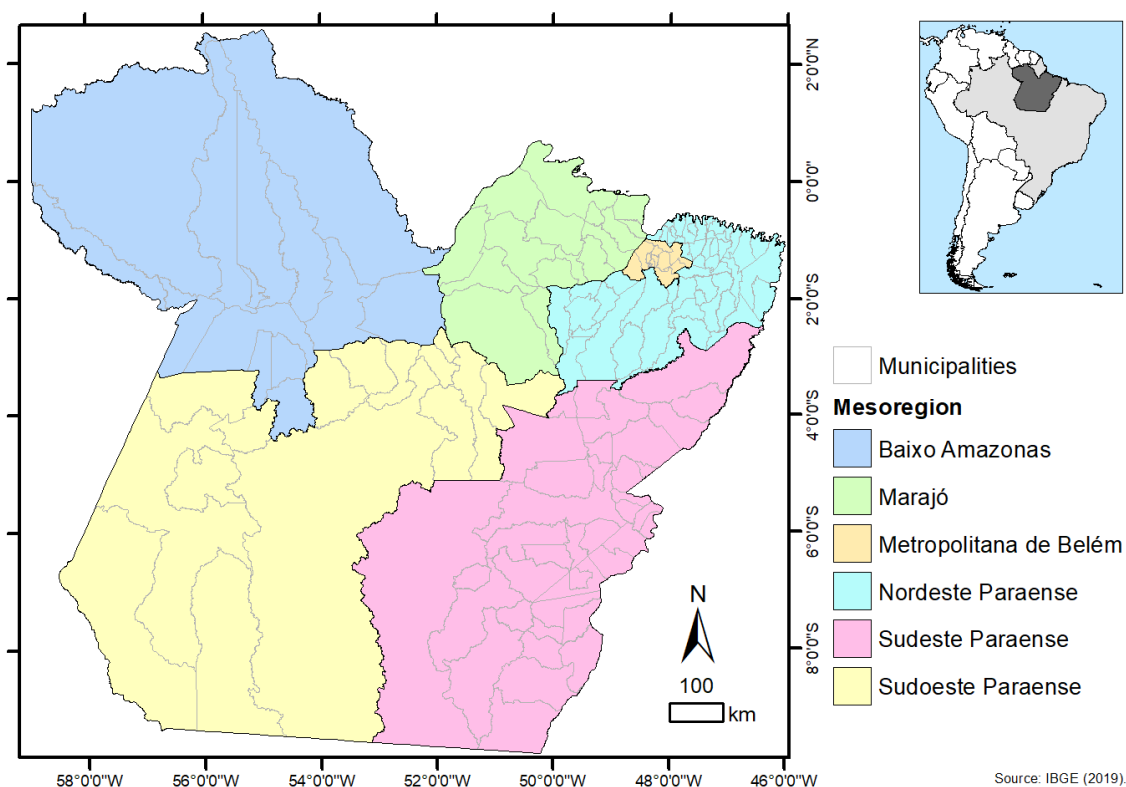
61 The arrival of the pandemic by COVID-19 weakened health and surveillance
62 services worldwide, and it was no different in Brazil and Pará. However, the state of Pará
63 already has local vulnerabilities, thus the objective of this study was to identify the
64 epidemiological pattern of live births before and during the pandemic of COVID-19 in the
65 state of Pará, 2016 to 2020.

66 **METHOD**

67 Epidemiological, ecological, and time-series study with data from DATASUS'
68 epidemiological surveillance of the Live Births Information System (SINASC). These are
69 data that have been treated by surveillance and are in an aggregated format.

70 The study population is the live births residing in the state of Pará (figure 1), in the
71 period from 2016 to 2020. The data were made available on the website of the Department of
72 Informatics of the Unified Health System (DATASUS) [7].

73 **Figure 1.** The spatial location of the mesoregions and municipalities of the State of Pará,
74 Amazon, Brazil.



75
 76 Source: (Sardinha, et al. 2021)[8].
 77

78 The instrument for data collection was the Live Birth Declaration (DNV), the
 79 variables, year, age group, type of pregnancy, type of delivery, prenatal consultations,
 80 education, congenital anomaly, gender, and type of congenital anomaly were extracted. The
 81 data were analyzed by Excel 2019, from absolute and relative numbers, as well as analysis of
 82 the curve of the number of live births per year by the R2 equation, which shows if there is a
 83 change in pattern and informs the percentage of the difference between the years. We
 84 performed the calculation of the birth rate by health region from the resident population also
 85 extracted from DATASUS, the calculation was:

$$86 \quad \frac{\text{Number of live birth}}{\text{Health Region Year Population}} \times 1.000$$

87
 88
 89

90 The spatial distribution of live births was performed by the health region of the state
91 of Pará in the ArcGIS software (<https://www.arcgis.com/>) and classified according to the
92 results of the birth rates, in five classes in red.

93 According to Resolution No. 510 of April 7, 2016, Article II, which deals with
94 research that uses publicly accessible data, under Law No. 12,527 of November 18, 2011,
95 Articles III (research that uses information in the public domain) and V (research in databases
96 whose information is aggregated, without the possibility of individual identification), will not
97 be registered or evaluated by the Ethics and Research Committee (CEP/CONEP) system.
98 Thus, these types of studies are not recommended to be submitted for ethical review and can
99 be freely conducted, since the publicly available data does not include data such as the names,
100 phone numbers, and addresses of the participants [9,10].

101 **RESULTS**

102 In the state of Pará, there were 689,454 live births in the study period, highlighting
103 the drop in the year 2020 which was 132,937, compared to 2019 that where 138,338. The
104 health regions with the highest numbers were Metropolitan I with 21.32%, Carajás with
105 11.26%, and Baixo Amazonas with 11.22%, proportional to being the most populous regions
106 (table 1).

107 In the analysis by the number of live births per year, the trend line showed the reduction of
108 live births each year, enhanced by 2020. The R2 value showed that each year the reduction
109 tends to be 23% (graph 1).

110 **Table 1** - Number of live births in the state of Pará by health region, from 2016 to 2020.

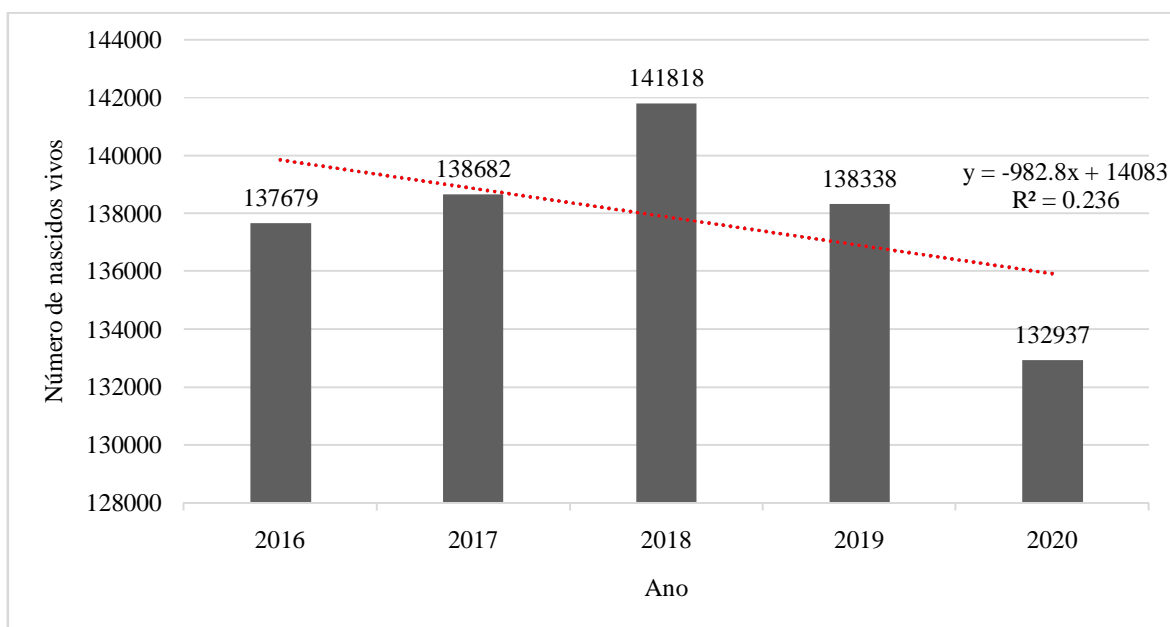
Health Region	2016	2017	2018	2019	2020	Total	%
Araguaia	7477	7812	8311	8020	7731	39351	5,71
Baixo Amazonas	14998	15422	15697	15810	15456	77383	11,22
Carajás	15629	15330	16130	15335	15224	77648	11,26
Lago de Tucuruí	6915	6844	6718	6474	6282	33233	4,82

Metropolitana I	30359	30529	30197	29137	26753	146975	21,32
Metropolitana II	6136	5981	6216	6106	5725	30164	4,38
Metropolitana III	13650	13605	14186	14109	13264	68814	9,98
Rio Caetés	8716	8557	8587	8314	8093	42267	6,13
Tapajós	3944	4409	4381	4360	4491	21585	3,13
Tocantins	11523	11768	12227	11957	11605	59080	8,57
Xingu	7009	6795	6970	6836	6575	34185	4,96
Marajó I	3969	3959	4075	4038	4025	20066	2,91
Marajó II	7354	7671	8123	7842	7713	38703	5,61
Total	137679	138682	141818	138338	132937	689454	100,00

111 Source: MS/SVS/DASIS - Live Births Information System - SINASC.

112

113 **Graph 1** - Number of live births per year, in the state of Pará from 2016 to 2020.



114

115 Source: MS/SVS/DASIS - Live Births Information System - SINASC.

116

117 We calculated the birth rate by health region, and also presented the spatial
118 distribution. The highest birth rates were and remain in the regions Marajó II (per year
119 23.86/24.58/25.69/24.49/23.80), Baixo Amazonas (per year 19.87/20.28/20.49/20.49/19.89),
120 Xingu (per year 20.67/19.82/20.11/19.52/18.58) and Tapajós (per year
121 18.01/20.07/19.87/19.72/20.25). The Metropolitan I (per year 13.85/13.83/13.58/13.02/11.87)

122 and Araguaia (per year 13.84/14.23/14.90/14.15/13.44) regions were and still are the lowest
 123 rates in the state of Pará (table 2) (graph 2) (figures 2, 3 and 4).

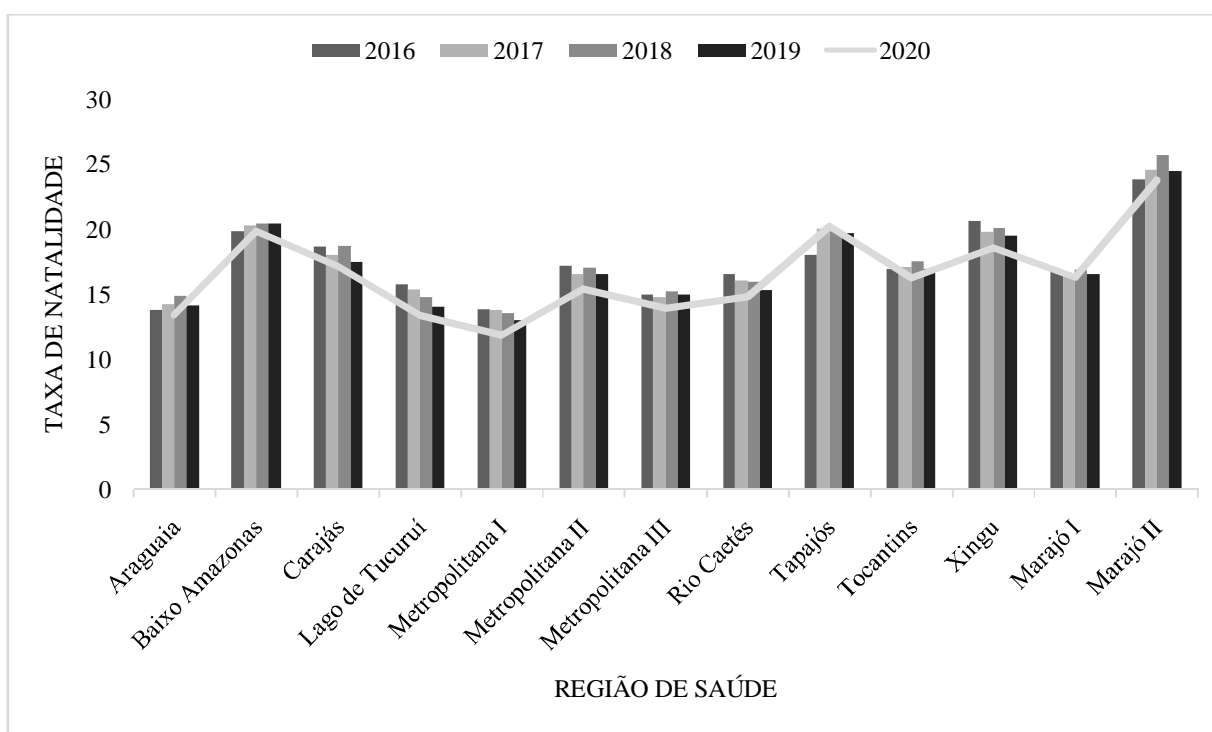
124

125 **Table 2** - Birth Rate per 1,000 population, health region in the state of Para 2016 to 2020.

Health Region	2016	2017	2018	2019	2020
Araguaia	13.84	14.23	14.90	14.15	13.44
Baixo Amazonas	19.87	20.28	20.49	20.49	19.89
Carajás	18.66	18.03	18.70	17.52	17.15
Lago de Tucuruí	15.82	15.37	14.81	14.03	13.38
Metropolitana I	13.85	13.83	13.58	13.02	11.87
Metropolitana II	17.19	16.59	17.08	16.61	15.43
Metropolitana III	15.02	14.81	15.27	15.02	13.97
Rio Caetés	16.53	16.09	16.00	15.36	14.83
Tapajós	18.01	20.07	19.87	19.72	20.25
Tocantins	16.98	17.12	17.56	16.96	16.26
Xingu	20.67	19.82	20.11	19.52	18.58
Marajó I	16.88	16.63	16.91	16.55	16.30
Marajó II	23.86	24.58	25.69	24.49	23.80
Total	16.52	16.47	16.66	16.08	15.30

126 Source: MS/SVS/DASIS - Live Births Information System - SINASC.

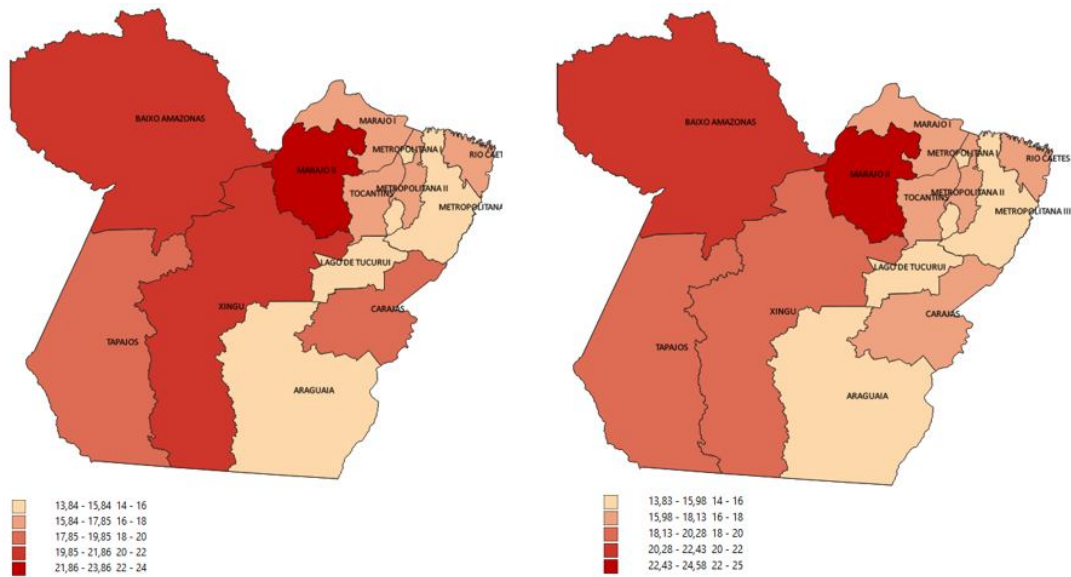
127 **Graph 2** - Birth Rate per 1,000 inhabitants, health region in the state of Para 2016 to 2020.



128

129 Source: MS/SVS/DASIS - Live Births Information System - SINASC.

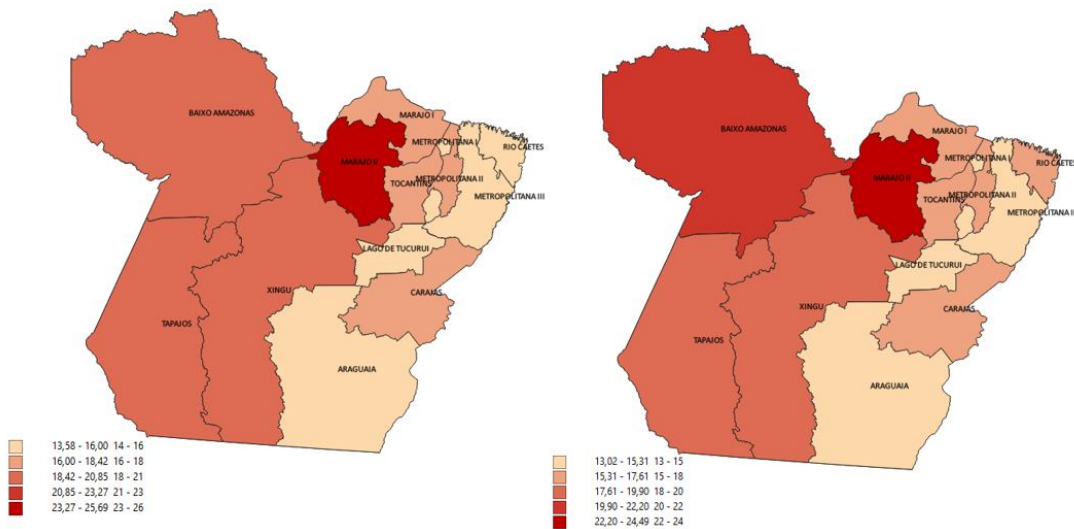
130 **Figure 2** - Spatial distribution of birth rate by health region in the state of Pará, 2016 and
131 2017.



133 Source: MS/SVS/DASIS - Live Births Information System - SINASC. Software ArcGIS
134 (<https://www.arcgis.com/>).

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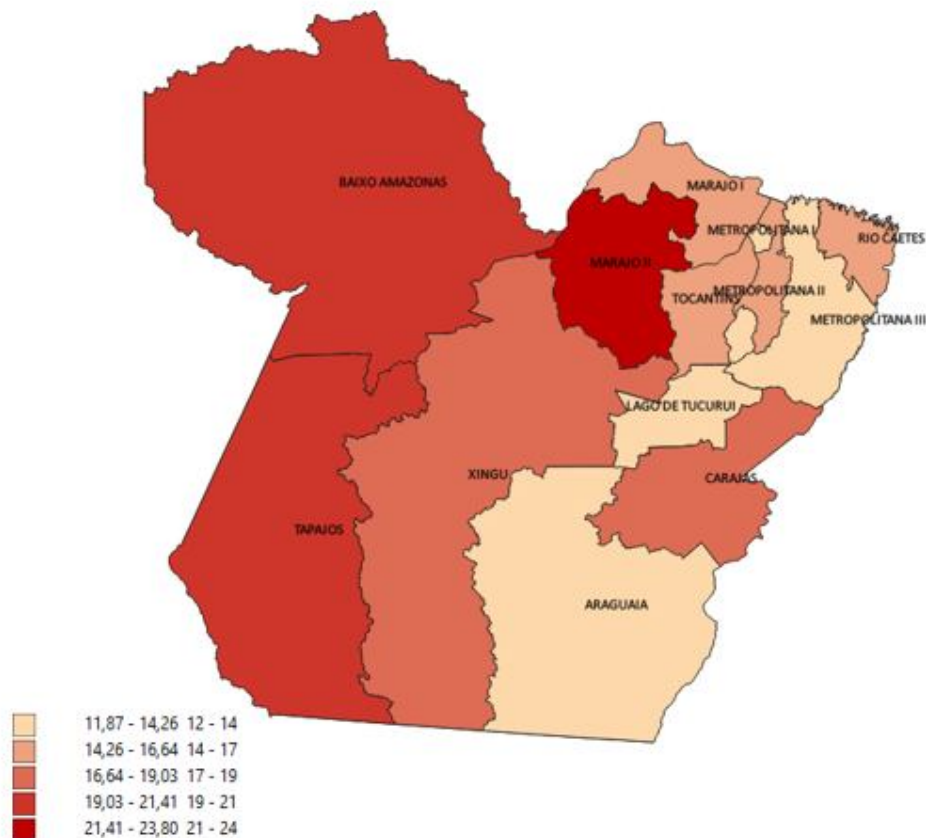
136 **Figure 3** - Spatial distribution of birth rate by health region in the state of Pará, 2018 and
137 2019.



139 Source: MS/SVS/DASIS - Live Births Information System - SINASC. Software ArcGIS
140 (<https://www.arcgis.com/>).

141

142 **Figure 4** - Spatial distribution of birth rate by health region in the state of Pará, 2020.



143

144 Source: MS/SVS/DASIS - Live Births Information System - SINASC. Software ArcGIS
145 (<https://www.arcgis.com/>).

146

147 Regarding sex, the live births in the study period represented (51.21%) male and
148 (48.77%) female, the remaining were ignored in the sex field. Regarding the age range, the
149 majorities of women were between 15 to 19 years (22.29%), 20 and 24 years (30.05%), and
150 25 to 29 years (22.58%). As well as the majority of single pregnancy type 98.32%. The
151 mother's schooling by the number of years of study, the majority presented 7 or more years
152 (48.10%), followed by 3 to 6 years (33.98%). In the comparison of schooling with the number
153 of prenatal visits, 8 to 11 years of study who made 7 visits or more (59.19%), and those who
154 did not make any visits with the same schooling was (35.78%) (table 3).

155 The single pregnancy type accounted for 98.33% of the live births. About the type of
156 delivery, 50.20% were vaginal and 49.70 were cesarean. Concerning prenatal consultations,
157 the majority had 7 or more 48.10%, followed by 4 to 6 consultations 33.98%. Regarding birth
158 weight, the study showed 52,378 (7.59%) live births with a low birth weight of <2,499 g. The
159 majority 64.61% weigh between 3000 to 3999 g (table 4).

160 **Table 3** - Sociodemographic variables of the mother and births by health region, state of Pará, 2016 to 2020.

Sex	2016	%	2017	%	2018	%	2019	%	2020	%	Total	%
Male	70645	10.25	71244	10.33	72745	10.55	70644	10.25	67791	9.83	353069	51.21
Female	67020	9.72	67422	9.78	69042	10.01	67671	9.82	65121	9.45	336276	48.77
Ignored	16	0.00	18	0.00	32	0.00	26	0.00	26	0.00	118	0.02
Age of mother												
Under 10 years old	-		-		-		2	0.00	-		2	0.00
10 to 14 years	2178	0.32	1867	0.27	1887	0.27	1816	0.26	1670	0.24	9418	1.37
15 to 19 years	33254	4.82	31949	4.63	31438	4.56	29504	4.28	27588	4.00	153733	22.30
20 to 24 years	42122	6.11	42050	6.10	42735	6.20	41002	5.95	39333	5.70	207242	30.06
25 to 29 years	30220	4.38	30841	4.47	32025	4.64	31797	4.61	30836	4.47	155719	22.59
30 to 34 years	19176	2.78	20158	2.92	21050	3.05	20956	3.04	20226	2.93	101566	14.73
35 to 39 years	8501	1.23	9367	1.36	10106	1.47	10575	1.53	10387	1.51	48936	7.10
40 to 44 years	2051	0.30	2268	0.33	2391	0.35	2486	0.36	2692	0.39	11888	1.72
45 to 49 years	160	0.02	166	0.02	162	0.02	174	0.03	172	0.02	834	0.12
50 to 54 years	12	0.00	12	0.00	15	0.00	24	0.00	24	0.00	87	0.01
55 to 59 years	2	0.00	4	0.00	3	0.00	1	0.00	-		10	0.00
60 to 64 years	1	0.00	-		6	0.00	-		2	0.00	9	0.00
65 to 69 years	-		-		-		-		2	0.00	2	0.00
Age ignored	4	0.00	2	0.00	1	0.00	4	0.00	6	0.00	17	0.00
Mother's schooling												
No	1453	0.21	1261	0.18	1131	0.16	1028	0.15	967	0.14	5840	0.85
1 to 3 years	7435	1.08	6523	0.95	6006	0.87	5303	0.77	4420	0.64	29687	4.31
4 to 7 years	37245	5.40	35860	5.20	35524	5.15	33360	4.84	30892	4.48	172881	25.07
8 to 11 years	74619	10.82	75430	10.94	76046	11.03	77584	11.25	76869	11.15	380548	55.19
12 years and older	13378	1.94	14983	2.17	16081	2.33	16077	2.33	16017	2.32	76536	11.10
Ignored	3551	0.52	4627	0.67	7031	1.02	4989	0.72	3773	0.55	23971	3.48

162 **Table 4 - Pregnancy and Birth Variables by health region, state of Pará, 2016 to 2020.**

Pregnancy Type	2016	%	2017	%	2018	%	2019	%	2020	%	Total	%
Single	135392	19.64	136509	19.80	139408	20.22	135921	19.71	130702	18.96	677932	98.33
Double	2058	0.30	1969	0.29	2202	0.32	2254	0.33	2071	0.30	10554	1.53
Triple and more	16	0.00	26	0.00	39	0.01	35	0.01	33	0.00	149	0.02
Ignored	215	0.03	180	0.03	170	0.02	131	0.02	132	0.02	828	0.12
Type of birth												
Vaginal	71213	10.33	70954	10.29	71553	10.38	68702	9.96	63701	9.24	346123	50.20
Cesarean	66259	9.61	67573	9.80	70139	10.17	69535	10.09	69144	10.03	342650	49.70
Ignored	209	0.03	157	0.02	127	0.02	104	0.02	93	0.01	690	0.10
Prenatal consultation												
None	8241	1.20	6586	0.96	6401	0.93	5457	0.79	7653	1.11	34338	4.98
From 1 to 3	16809	2.44	17580	2.55	17428	2.53	15836	2.30	18649	2.70	86302	12.52
From 4 to 6	48595	7.05	48056	6.97	48342	7.01	45203	6.56	44095	6.40	234291	33.98
7 or more	63519	9.21	65987	9.57	69028	10.01	71451	10.36	61660	8.94	331645	48.10
Ignored	517	0.07	475	0.07	620	0.09	394	0.06	881	0.13	2887	0.42
Birth Weight												
Less than 500g	208	0.03	198	0.03	225	0.03	221	0.03	200	0.03	1052	0.15
500 to 999g	481	0.07	553	0.08	546	0.08	556	0.08	507	0.07	2643	0.38
1000 to 1499g	846	0.12	884	0.13	901	0.13	837	0.12	832	0.12	4300	0.62
1500 a 2499g	8687	1.26	8868	1.29	9180	1.33	8982	1.30	8666	1.26	44383	6.44
2500 a 2999g	30810	4.47	30259	4.39	31165	4.52	30285	4.39	29129	4.22	151648	22.00
3000 to 3999 g	88833	12.88	89820	13.03	91449	13.26	89489	12.98	85902	12.46	445493	64.61
4000g and above	7664	1.11	7942	1.15	8197	1.19	7871	1.14	7579	1.10	39253	5.69
Ignored	152	0.02	160	0.02	156	0.02	100	0.01	123	0.02	691	0.10

163 Source: MS/SVS/DASIS - Live Births Information System - SINASC.

165 **Table 5** - Occurrence of congenital anomalies by health region, state of Pará, 2016 to 2020.

Congenital anomaly	2016	%	2017	%	2018	%	2019	%	2020	%	Total	%
Yes	626	0.09	699	0.10	778	0.11	753	0.11	757	0.11	3613	0.52
No	135516	19.66	137475	19.94	140105	20.32	135385	19.64	129587	18.80	678068	98.35
Ignored	1539	0.22	510	0.07	936	0.14	2203	0.32	2594	0.38	7782	1.13
Type of congenital anomaly												
Spina bifida	16	0.00	20	0.00	27	0.00	26	0.00	20	0.00	109	0.02
Other congenital malformations of the nervous system	126	0.02	109	0.02	122	0.02	95	0.01	83	0.01	535	0.08
Congenital malformations of the circulatory system	9	0.00	17	0.00	29	0.00	40	0.01	43	0.01	138	0.02
Cleft lip and cleft palate	59	0.01	68	0.01	66	0.01	59	0.01	68	0.01	320	0.05
Absent atresia and stenosis of the small intestine	-		6	0.00	3	0.00	2	0.00	2	0.00	13	0.00
Other congenital malformations of the digestive system	30	0.00	43	0.01	63	0.01	79	0.01	77	0.01	292	0.04
Undescended testicle	3	0.00	4	0.00	4	0.00	7	0.00	7	0.00	25	0.00
Other genitourinary system malformations	29	0.00	29	0.00	48	0.01	42	0.01	39	0.01	187	0.03
Congenital deformities of the hip	-		-		1	0.00	4	0.00	-		5	0.00
Congenital deformities of the feet	95	0.01	102	0.01	115	0.02	118	0.02	107	0.02	537	0.08
Other congenital malformations and deformities of the musculoskeletal system	164	0.02	201	0.03	189	0.03	171	0.02	195	0.03	920	0.13
Other congenital malformations	77	0.01	67	0.01	76	0.01	80	0.01	88	0.01	388	0.06
Chromosomal anomalies NCOP	15	0.00	30	0.00	30	0.00	27	0.00	27	0.00	129	0.02
Hemangioma and lymphangioma	-		1	0.00	3	0.00	2	0.00	-		6	0.00
No congenital anomaly/not informed	137058	19.88	137987	20.01	141043	20.46	137589	19.96	132182	19.17	685859	99.48

166 Fonte: MS/SVS/DASIS - Sistema de Informações sobre Nascidos Vivos – SINASC.

167 The occurrence of congenital anomalies represented 0.52% of live births, 0.55% male, and
 168 0.47% female (table 6). We analyzed the types of congenital anomalies, Other congenital
 169 malformation and deformity were the most prevalent 25.53%, followed by Congenital deformities
 170 of the feet 14.90%, Other congenital malformations of the nervous system 14.84%, Other
 171 congenital malformations 10.77%, Cleft lip and cleft palate 8.88%, Other congenital malformations
 172 digestive tract 8.10%. The others represent less than 6% each (table 5 and 6).

173 **Table 6** - Live births by type of congenital anomaly, Pará state 2016 to 2020.

Congenital anomaly type	Total (3604)	%
Other congenital malformations and deformities of the musculoskeletal system	920	25.53
Congenital deformities of the feet	537	14.9
Other congenital malformations of the nervous system	535	14.84
Other congenital malformations	388	10.77
Cleft lip and cleft palate	320	8.88
Other congenital malformations of the digestive tract	292	8.1
Other congenital malformations of the genitourinary system	187	5.19
Congenital malformations of the circulatory system	138	3.83
Chromosomal abnormalities NCOP	129	3.58
Spina bifida	109	3.02
Undescended testicle	25	0.69
Absent atresia and stenosis of the small bowel	13	0.36
Hemangioma and lymphangioma	6	0.17
Congenital hip deformities	5	0.14

174 Source: MS/SVS/DASIS - Live Births Information System - SINASC.

175

176 **DISCUSSION**

177 In this study, we characterized the live births of the state of Pará in the years 2016 to 2020,
 178 based on data from the epidemiological surveillance of live births in Brazil SINASC. On the
 179 number of live births, we evidenced a reduction in the trend line, which was potentiated in 2020.
 180 According to the civil registry, an official page that shares data on births shows that in 2021 in the

181 state of Pará there were 121,739 births, and highlights that with the arrival of the pandemic in Brazil
182 births reduced by 15%, but emphasizes that the birth rate decline had already been occurring [11].

183 A report in the CNN Brazil newspaper emphasized the reduction of the fertility rate in
184 Brazil, which was enhanced by the pandemic of COVID-19. They highlighted that the fear and
185 anguish of staying in a maternity ward in times of pandemic, emotional issues, and worries about
186 SARS-CoV-2 are associated with this reduction [12].

187 Studies also showed that maternal mortality increased during the pandemic and that it was
188 directly associated with COVID-19. In 2021, Brazil had the highest maternal mortality rate for
189 COVID-19 in the world, which alerted researchers, because due to underreporting these data can be
190 even higher, as COVID-19 is potentiated during pregnancy due to various physiological changes
191 [13,14]. Research on maternal mortality in the state of Pará showed that 44 maternal deaths had
192 occurred by June 8, 2020, of which 20 were due to COVID-19. [15].

193 Regarding the birth rate reduction, a 2012 study already discussed the demographic
194 transition since 1950, highlighting the declines in mortality, birth rate, and fertility in this process,
195 but emphasized that in the North and Northeast of Brazil this process was less evident [16]. Another
196 study analyzed the fertility transition based on epidemiological data, and stated that the drop in
197 fertility began in the mid-1930s in Brazil, especially in the South and Southeast regions, and also
198 cited in the study factors regarding the reduction, such as women's choice to have fewer children,
199 low social cost, contraceptive methods, and education [17].

200 Research in the municipality of Rio de Janeiro on the epidemiological profile of live births
201 showed that most were full-term, adequate weight, and Apgar score on the first and fifth minutes
202 between 7 and 10 points. The mothers were mostly brown, single, with 8 to 11 years of schooling,
203 and aged between 20 and 34. Regarding the type of delivery, Cesarean was more frequent [18].
204 Being similar concerning age, and education, however different in the type of delivery, because in

205 our study the predominance was a vaginal delivery, even with little difference between the cesarean
206 delivery. Another study described the profile of live births in the city of Viçosa from 2001 to 2007,
207 showing the main age range of mothers was between 20 and 29 years, representing 55% of this age
208 group in 2007. The percentage of teenage mothers decreased from 18.2 to 14.6% from 2001 to
209 2007. Concerning the type of delivery, an increase in cesarean sections and a decrease in vaginal
210 deliveries are emphasized. However, vaginal deliveries are higher than cesarean deliveries among
211 adolescents. As for weight, low birth weight reached 8% in 2007. The Apgar score in the first and
212 fifth minutes >7 represented 73 and 89% in 2007. [19].

213 A study aimed to know the epidemiological profile of births in Chapecó/SC, in the period
214 from July 2011 to June 2013, based on SINASC. They identified a total of 5,918 live births, of these
215 9.2% were born weighing less than 2,500 g; 9.4% were premature; 15.7% were children of
216 adolescent mothers, and 20% of women had seven prenatal visits or less [20]. In our study, the
217 majority had 7 or more prenatal visits, and the prevalence of low weight was lower.

218 Regarding the prevalence of congenital anomalies, a study described congenital anomalies
219 (CA) among live births of mothers residing in Tangará da Serra, MT, Brazil, the period 2006-2016.
220 Of 15,689 live births, 77 were registered (prevalence of 4.9/1,000); there was an 80.7% increase in
221 CA registered in 2016, representing 10.3/1.000 live births, including five cases of microcephaly;
222 The prevalence of CA was higher among children born to women aged over 35 years (prevalence
223 ratio [PR] =1.91; confidence interval [95% CI] 1.01;3.60), premature infants (PR=2.22; 95% CI
224 1.26;3.92) and low birth weight infants (PR=3.21; 95% CI 1.86;5.54) [21].

225 Concerning the higher birth rates in the health regions of Marajó II, Baixo Amazonas, and
226 the Tapajós, they are associated with lower schooling and less access to health services that these
227 regions have characteristics of local vulnerability because they have a large geographical extension

228 and have many people in rural and indigenous areas. It is worth mentioning that these are regions of
229 illegal mining and environmental contamination from mercury [22,23].

230 Regarding the quality of the SINASC information, a study highlighted the weaknesses in
231 the completeness of the essential fields in the surveillance of live births, and that these indicators
232 are worse in the northern region of the country [24]. In another study in Brazil from 2006 to 2010
233 on the completeness of the variables of the DNV, 21 of the 23 variables analyzed showed
234 completeness above 90.0%. 97.9% of the hospital delivery variables had complete data; they found
235 no differences in the proportion of births concerning macroregion and sex concerning the 2010
236 census; 82.6% of the data were received on time in 2010; the ratio between live births notified and
237 estimated was 89.4% in 2006 and 97.4% in 2010 [25]. Another study conducted a review of data
238 completeness, from previously published studies, 13 articles were reviewed. The evaluation of
239 coverage was the subject of analysis in eight studies, completeness in four, and reliability in seven.
240 Most of them presented results of coverage higher than 90%, indicating their feasibility for the
241 calculation of indicators. However, under-registration of births in SINASC prevailed, ranging from
242 75.8% to 99.5%. The variables maternal education, parity, and the number of prenatal visits were
243 those that presented the greatest inconsistency. Thus, the variable parity was the one that presented
244 the greatest incompleteness [26].

245 The impossibility of including the data of live births from 2021 stands out as a limitation
246 because the DATASUS surveillance system only makes the data available after the treatment of the
247 data and the qualification of the information, and in Brazil generally the availability of data from
248 the previous year is only made in October to December of the current year.

249 **CONCLUSION**

250 We presented the epidemiological pattern of live births in the state of Pará, before and
251 during the pandemic of COVID-19, and showed that the demographic transition had already been

252 occurring for several decades, including the reduction of fecundity and birth rate, thus our study
253 showed that the reduction in the number of live births was already a reality in the country, but we
254 emphasized that this reduction was enhanced by the pandemic.

255 The other variables were similar, except for the higher prenatal care adherence which was
256 better than the previous studies, and the lower prevalence of low weight, but the limitation was that
257 studies in the same place of the research were not found.

258 Regarding the incompleteness of the data, we highlight the ignored fields that reflect the
259 fragility in the surveillance of live births, which was reinforced by the literature. Health promotion
260 should be strengthened concerning the qualification of surveillance professionals, and the theme
261 should be discussed with greater accuracy in the academies for training health professionals.

262 **Disclaimer**

263 This paper is an extended version of a preprint document of the same author.

264 The preprint document is available in this link:
265 <https://www.medrxiv.org/content/10.1101/2022.09.02.22279455v1.full.pdf>

266 [As per journal policy, pre-print article can be published as a journal article, provided it is
267 not published in any other journal]

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