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Cohort profile: Jiaxing Birth Cohort (JBC) in China

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Title: Cohort profile: Jiaxing Birth Cohort (JBC) in China

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Why was the cohort set up?

Childhood obesity is becoming an emerging public health issue worldwide, owing to its association with a variety of health problems at younger ages in adulthood, including obesity, type 2 diabetes and cardiovascular diseases [1]. Identification of prenatal and early life risk factors is key for curbing the epidemic of the childhood obesity. Previous evidence has found a variety of risk factors for childhood obesity, such as maternal obesity, gestational weight gain, birth weight, weight gain during infancy, breastfeeding and genetic variations [2]. However, most of the evidence comes from results of Western populations, with evidence rather insufficient and limited in Chinese populations. The prevalence of overweight and obesity combined in Chinese students aged 7-18 has increased by 0.10% during 1985-1995, by 0.30% during 1995-2000, and by 0.23% for both periods of 2000-2005 and 2005-2010 [3]. Among the student aged 7-18, the age-adjusted prevalence of obesity and of overweight and obesity combined was 8.1% and 19.2%, respectively in 2010 [3, 4]. To curb the sparkly increased prevalence of childhood obesity in China, it is crucial to identify risk factors of childhood obesity via large prospective cohort studies. The currently available birth cohort studies in China are either limited in sample size or relying on data more than 20 years ago [5-10]. A more contemporary large birth cohort is lacking. Furthermore, patterns of the change in prenatal risk factors and early life feeding practice over the past decade in China, and their influence on the growth pattern/adiposity among Chinese children are both not clear.

Between 1993-1996, a large population-based health surveillance system for the Collaborative Project-China was established in one northern province of China (Hebei) and two southern provinces (Zhejiang [Jiaxing area] and Jiangsu) to evaluate the preventive potential of folic acid for neural tube defects and other external structural birth defects [11, 12].

The aforementioned project created a mature monitoring system for registration of women during their premarital health examination or at any stage of pregnancy [12], and for the follow-up of the children born to the enrolled women [13]. From 1999, the Jiaxing Birth Cohort was established based on the existing monitoring system in the Jiaxing area (a middle-income area) previously enrolled in the birth defect surveillance system. Women in the Jiaxing area were registered at the monitoring system in any stage of their pregnancies, and were followed up until the birth of their children. The children born to the registered women continued to be followed-up regularly until 6-7 years of age before they went to school. Detailed maternal characteristics during pregnancy, early life feeding practice, and children characteristics (such as anthropometric status, dietary preference) were recorded via in-person interview during the follow-up. Thus, the Jiaxing Birth Cohort is a unique resource to explore the prenatal risk factors, early life feeding practice and growth pattern/adiposity in Chinese children. In addition, the Jiaxing Birth Cohort enables us to have a contemporary view of change in maternal and children characteristics and their impact on the children growth in the past decade in this region.

Who is in the cohort, how often have they been followed-up?

The cohort was set at Jiaxing area, a prefecture-level city, which includes 7 county-level divisions (Haining, Haiyan, Nanhu, Jiashan, Pinghu, Tongxiang and Xiuzhou). Jiaxing is located around 100 km southwest of Shanghai (**Figure 1**), with a middle-level socio-economic development in China, and a permanent population of 4.558 million at the end of the 2013 census [14].

Women at one of the seven divisions/counties in the Jiaxing area were registered at the local clinics before pregnancy or at their first, second or third trimester of pregnancy (covering >95% of pregnant women in the region). After registration, participants were asked to visit the local clinics regularly until the birth of their children (once per four weeks between 16-28 weeks of pregnancy; once per two weeks between 28-36 weeks of pregnancy; once per week after 36 weeks of pregnancy). Between 1999 and 2013, 363 416 pregnancies were followed from initial registration to the end of the pregnancy, with 25 003 children born to the above women having no further information (registration) after the birth. Therefore, a total of 338 413 live mother-child pairs registered at local clinics, and were enrolled in the Jiaxing Birth Cohort. Among the 338 413 children, there were 332 532 singletons, 2883 pairs of twins (n=5 766), 37 pairs of triplets (n=111), and 1 pair of quadruplets (n=4).

One-two months (42-56 days) after the birth, both the mother and her child visited the clinic for the first health check. Thereafter, the children were asked to visit the clinic for health examination and anthropometric measurement (weight, height, head circumference, and bregma) at 3, 6, 9 and 12 months of age (infancy stage). In the toddler stage (12-36 months), children were asked to visit local clinics every 6 months (18, 24, 30, 36) until they were 36 months of age. Thereafter, children came to visit the clinics once per year until 6-7 years of age (72-84 months) before they went school.

What have been measured?

Women

Detailed maternal characteristics were recorded at the enrolment and during pregnancy via questionnaires administered at interview by trained nurses/doctors. The same structured

questionnaires were used across all the local clinics from 1999 to 2013. No specific procedure was implemented to examine the uniformity between the ways the information via questionnaire was collected over the recruiting years.

As shown in **Table 1**, women enrolled between 1999-2003 tended to be younger and having lower BMI than women enrolled between 2004-2008, or between 2009-2013. In addition, women enrolled at earlier recruiting years had later menarcheal age, lower educational level, more likely to be nulliparous and do farm work/housework compared with women participated at later recruiting years. The prevalence of current smoking and alcohol drinking during pregnancy was generally very low, which was slightly higher among women at later recruiting years. The prevalence of preterm birth was higher, while Caesarean-section lower, for women enrolled between 2009-2013 than women enrolled between 2004-2008, or between 1999-2003.

Children

During the follow-up, we obtained questionnaire information from 249 113 infants at the 42-56 days' visit. Subsequently, 195 833, 158 506, 151 542 and 133 195 infants provided follow-up information at the 3th, 6th, 9th and 12th month' visit, respectively (**Figure 2**). Within this period of follow-up, detailed breastfeeding status, formula feeding practice, and solid food introduction (including fish liver oil, liver oil, rice cereal/porridge, egg yolk, fish paste, liver past, tofu, animal blood, bread/steamed bun/fine dried noodle, ground meat/soy product, and pureed noodle/cookies) were recorded through in-person interview. In addition, blood haemoglobin and anthropometric parameters, including body weight, height, head circumference, and bregma were measured on site (**Table 2**).

After 12 months' follow-up, the children were invited to visit the local clinics every 6 months until 36 months old (toddler stage), with a total of 195 292 children visiting the local clinics at least once during the toddler stage up to June 2013. Follow-up rate for the toddler stage was quite high, with 183 864 children (70.8%) being successfully followed up by June 2013 among 259 835 children who were enrolled at baseline between 1999 and June 2010. Maternal characteristics were quite different between children with and without follow-up information within this toddler stage. Mothers of the children being successfully followed up were younger, more likely to be recruited at the first trimester or before pregnancy, better educated, more likely to have routine jobs, more likely to have no parity history, lower prevalence of preterm birth, but higher prevalence of Caesarean-section (**Table 3**).

After 3 years old, 120 900 children provided follow-up information between 4-7 years of age (pre-school stage) up to June 2013. Difference in maternal characteristics between children being successfully followed up at this stage and children dropped out followed similar pattern as those in the aforementioned toddler stage, with a follow-up rate of 68.9% (**Table 4**).

In both toddler and pre-school stages, anthropometric parameters (weight, height, head circumference, chest circumference and mid-upper arm circumference) and nutritional status (blood haemoglobin, zinc, lead and copper) were measured; and dietary intake, behaviour information and healthy status were recorded via on-site interview (**Table 2**). All the laboratory measurements were conducted by local laboratories with the same standardised methods over the recruiting years. However, no specific quality control procedures were conducted to assess the uniformity/compatibility of the methods used over the recruiting years.

What has it found? Key findings and publications

Prospective evidence for the association between early life feeding practice (including breastfeeding, complementary feeding) and childhood adiposity in Chinese populations is limited, with several publications from the Hong Kong's 'Children of 1997' birth cohort [15, 16]. The Jiaxing Birth Cohort provides a unique opportunity to examine these associations in an extremely large dataset of mainland Chinese population.

Using the data from the Jiaxing Birth Cohort, we examined 97,424 children with complete records on breastfeeding status at 1, 3 and 6 months of age, and followed them until they were 4-5 years of age for the measurement of body weight and height [17]. We found that a longer duration of exclusive breastfeeding was associated with lower risk of childhood overweight (BMI-z-score≥2, P-trend=0.009), and being at risk of overweight (2>BMI-z-score≥1, P-trend<0.001) at 4-5 years old. Specifically, exclusive breastfeeding for 3-5 months and ≥ 6 months, compared with <1 months, had 13% (relative risk=0.83; 95%CI: 0.71, 0.98) and 27% (relative risk=0.65; 95%CI: 0.47, 0.91) lower risk of becoming overweight. In addition, a longer duration of exclusive breastfeeding was associated with a lower BMI z-score at 4-5 years old in this population.

We further examined the association of timing and type of complementary feeding with childhood adiposity at 4-5 years of age [18]. Early introduction of complementary foods was associated with greater BMI z-score (P-trend<0.001) and higher risk of overweight (2>BMI-z-score≥1, P-trend=0.033). Consistent with some previous evidence [19, 20], we found that introduction of complementary foods between 4-6 months was more favourable to prevent childhood overweight than introduction of complementary foods before 3 months of age. Our study also demonstrated that among different types of complementary foods, early introduction of fish liver oil was the driven factor for the association of complementary foods introduction with childhood adiposity [18].

In addition to the above topic of interest, with follow-up information from pregnant women in the Jiaxing Birth Cohort, we were also able to evaluate the association of prenatal risk factors with different birth outcomes. For example, among 240,954 pregnant women in the cohort, we found that pre-conceptional folic acid supplementation was associated with lower risk of preterm birth and small-for-gestational-age birth [21].

Our plans for the future of this ongoing cohort study are:

a. Within the existed framework of the Jiaxing Birth Cohort, children born in this region will be continuously recruited and followed up before they go to school. This will increase the size of the same cohort and, more importantly, will enable us to compare the change of maternal/children characteristics and growth pattern by the years the mother-child pairs are recruited, which is important in terms of policymaking recommendation for the government and public health monitoring.
b. With existing dataset of the Jiaxing Birth Cohort updated at 2013, we will examine the association of prenatal risk factors (such as pregnant blood pressure and anaemia), early life feeding practice/diet with childhood adiposity up to 6-7 years of age. In addition, potential determinants of childhood anaemia or other diseases and risk factors will also be examined in the future.
c. With further external funding, we will start to follow up children in the cohort after they go to school. In terms of life course epidemiology, it is highly important to follow these children up until their adolescent and adulthood, thereby furthering our understanding the role of prenatal risk factors and early life feeding practice on chronic diseases development in adolescent and in late life.

What are the main strengths and weaknesses?

The main strength of the Jiaxing Birth Cohort is its extremely large sample size, covering the majority of the children born since 1999 in the Jiaxing area. To our knowledge, this is the largest birth cohort in Chinese populations. In addition, we followed these children quite intensively, with carefully recording their dietary intake, behaviour information, and growth pattern in the first few years of life. The main weakness of the present cohort is that we did not collect biological samples from these participants due to the extremely high cost for this kind of large study. However, with further funding, we may start collecting blood, urine, saliva and toenail samples in the participants newly enrolled in the cohort and in participants further followed up beyond the pre-school stage.

Can I get hold of the data? Where can I find out more?

We do not have resources or funding to support the open access to the cohort data. However, we are open to collaboration with other groups in the field.

JBC profile in a nutshell

- The Jiaxing Birth Cohort (JBC) is the largest prospective cohort study to explore the prenatal risk factors, early life feeding practice and growth pattern/adiposity in Chinese children.
- Between 1999 and 2013, 338 413 mother-child pairs were recruited in Jiaxing area at southeast China.
- Children of the recruited women were followed up at 1-2, 3, 6, 9, 12 months of age, and subsequently followed up every 6 months to 36 months of age (toddler stage), and every year to 6-7 years of age before they went to school (pre-school stage). Follow-up rate was 70.8% at toddler state and 68.9% at pre-school stage up to June 2013.
- The dataset comprises a variety of demographics, anthropometric, nutritional and behaviour information for the recruited children up to 6-7 years old.
- Jiaxing Birth Cohort welcomes specific queries and proposals for collaboration.

Pocket Profiles

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Key words: birth cohort, China, cohort profile

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Cohort purpose: The Jiaxing Birth Cohort is the largest prospective cohort study to explore the prenatal risk factors, early life feeding practice and growth pattern/adiposity in Chinese children.

Cohort Basics: Between 1999 and 2013, 338 413 mother-child pairs were recruited in Jiaxing area at southeast China.

Follow-up and attrition: Children of the recruited women were followed up at 1-2, 3, 6, 9, 12 months of age, and subsequently followed up every 6 months to 36 months of age (toddler stage), and every year to 6-7 years of age before they went to school (pre-school stage). Follow-up rate was 70.8% at toddler state and 68.9% at pre-school stage up to June 2013.

Design and Measures: The dataset comprises a variety of demographics, anthropometric, nutritional and behaviour information for the recruited children up to 6-7 years old.

Unique features: Detailed dietary information at different stages of the children up to 6-7 years old were recorded, as well as anthropometric measurements.

Reasons to be cautious: The Jiaxing Birth Cohort mainly represents a population in southeast China.

Collaboration and data access: The Jiaxing Birth Cohort welcomes specific queries and proposals for collaboration (to Professor Duo Li, email: duoli@zju.edu.cn)

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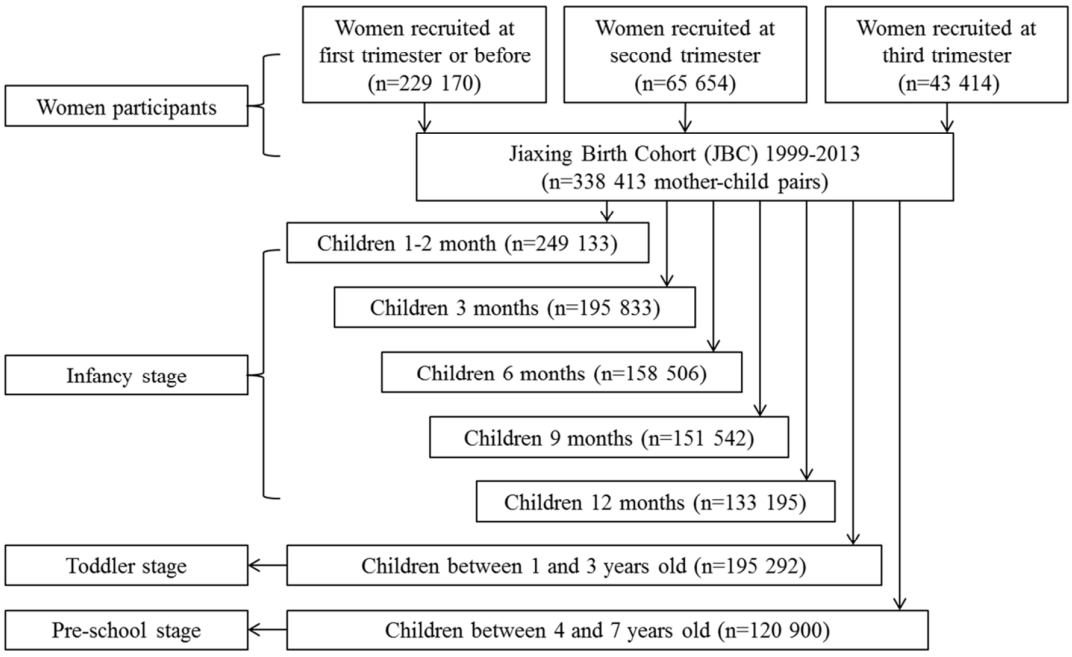

Flow chart of the Jiaxing Birth Cohort

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Table 1 Baseline maternal characteristics of recruited children by recruiting years in the Jiaxing Birth Cohort

	Overall (n=338 413)		1999-2003 (n=85 999)		2004-2008 (n=135 221)		2009-2013 (n=117 193)	
	Percent	N	Percent	N	Percent	N	Percent	N
Maternal age at pregnancy, y								
≤25	56.7	191 755	60.2	51 768	56.6	76 422	54.3	63 565
26-30	29	97 843	27.1	23 287	29	39 130	30.3	35 426
31-35	12.2	41 201	11.8	10 159	12.4	16 697	12.3	14 345
≥36	2.2	7 433	0.9	754	2.1	2 889	3.24	3 790
Maternal BMI, kg/m^2								
<18.5	15.5	51 579	18.4	15 684	15.5	20 547	13.4	15 348
18.5-24.9	70.8	235 691	74.9	63 870	70.4	93 588	68.2	78 233
25-29.9	12	39 774	6.1	5 166	12.3	16 363	15.9	18 245
≥30	1.7	5 717	0.6	504	1.8	2 338	2.5	2 875
Recruiting time point								
First trimester or before	67.8	229 170	84.9	72 992	66.1	89 308	57.1	66 870
Second trimester	19.4	65 654	13.3	11 423	19.5	26 342	23.8	27 889
Third trimester	12.8	43 414	1.8	1 550	14.4	19 514	19.1	22 350
Menarcheal age, y								
<14	17.3	58 449	13.4	11 434	16.9	22 729	20.8	24 286
14-15	61.7	208 001	58.1	49 728	61.9	83 407	64.1	74 866
>15	21	70 851	28.6	24 459	21.3	28 657	15.2	17 735
Maternal education								
<High school	67.9	228 657	79.1	67 978	68.9	92 653	58.6	68 026
High school	16.2	54 420	16	13 723	16.8	22 659	15.5	18 038
>High school	15.9	53 481	4.9	4 247	14.3	19 223	25.9	30 011
Maternal occupation								
Farm work/housework	64.7	218 269	68.8	59 156	64.5	86 845	62	72 268

Routine job	22.5	75 869	25.8	22 192	22.4	30 145	20.2	23 532
Others	12.8	43 222	5.3	4 592	13.2	17 766	17.9	20 864
Parity (>1 pregnancy)	26.5	89 678	19.6	16 835	25.1	33 947	33.2	38 896
Current smoking (yes)	0.2	663	0.14	115	0.19	257	0.25	291
Current alcohol drinking (yes)	0.64	2 143	0.14	118	0.6	808	1.04	1 217
Preterm birth (yes)	4.04	13 563	3.83	3 284	4.01	5 377	4.22	4 902
Caesarean-section (yes)	59	197 555	69.8	59 763	62.4	83 333	47.11	54 459
Infant sex, %male	52.4	176 005	51.4	44 169	52.6	70 356	53	61 480
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Gestational weeks, wk	39.2	1.56	39.2	1.48	39.1	1.55	39.2	1.62
Infant birth weight, g	3321.4	453.8	3305.9	444.4	3325.6	450.7	3327.8	463.8

Difference in categorical variables across the three periods was examined by Chi-square test. ANOVA was used to examine difference between the three periods in continuous variables. *P*-trend <0.001 for all the above variables.

Table 2 Data collection at different phases of the Jiaxing Birth Cohort

Phase	Measurements	Method
Pregnancy		
At recruitment	Anthropometrics, blood pressure, blood haemoglobin	Clinically measured
	Disease history, family history of disease, smoking status, alcohol drinking, menarcheal age, marital status, pregnancy history, folic acid supplementation; husband's disease history, family history of disease and lifestyle (smoking and alcohol drinking status)	Self-reported from interview
Visits before delivery	Anthropometrics, blood pressure, haemoglobin, blood platelet count, urine glucose, urine protein, foetal movement count, foetal heart rate	Clinically measured
Birth time	Blood pressure before and after delivery, foetal heart rate, delivery mode, complications of the mother during delivery, birth weight, birth length, Apgar score at 1 and 5 min	Clinically measured
Infancy (at 1-2, 3, 6, 9, 12 months of age)		
	Anthropometrics, blood haemoglobin	Clinically measured
	Breastfeeding status, complementary food feeding, sleeping time, healthy status	Self-reported from interview
Toddler (18, 24, 30, 36 months of age)		
	Anthropometrics, blood haemoglobin, blood zinc, lead, copper levels	Clinically measured
	Dietary preference, appetite, outdoor physical activity, language/cognitive development, other	Self-reported from interview

	behaviour information, healthy status	
Pre-school (4-7 years of age)		
	Anthropometrics, blood haemoglobin, blood zinc, lead, copper levels	Clinically measured
	Dietary preference, snacking behaviour, outdoor physical activity, language/cognitive development, other behaviour information, healthy status	Self-reported from interview

Table 3 Maternal characteristics for children with and without followed-up information between 1-3 year old (toddler stage)

	Overall (n=259 835)		Children with follow-up information between 1-3 years old (183 864)		Children without follow-up information between 1-3 years old (75 971)		*P*-value
	Percent	N	Percent	N	Percent	N	
Maternal age at pregnancy, y							<0.001
≤25	57.4	149040	58.9	108165	53.9	40875	
26-30	28.4	73745	29.1	53479	26.7	20266	
31-35	12.3	31911	10.7	19639	16.2	12272	
≥36	1.93	5002	1.37	2512	3.28	2490	
Maternal BMI, kg/m2							<0.001
<18.5	15.9	40740	18.8	34143	8.94	6597	
18.5-24.9	71.1	181912	74.2	134912	63.7	47000	
25-29.9	11.3	28849	6.34	11530	23.5	17319	
≥30	1.64	4196	0.72	1314	3.91	2882	
Recruiting time point							<0.001
First trimester or before	69.9	181512	83.8	181512	36.2	27501	
Second trimester	18	46706	14.3	46706	27	20490	
Third trimester	12.1	31478	1.94	31478	36.8	27907	
Menarcheal age, y							<0.001
<14	16	41445	15.6	28660	16.9	12785	
14-15	61	158006	59.6	109266	64.4	48740	
>15	23	59479	24.7	45350	18.7	14129	
Maternal education							<0.001
<High school	72.1	186439	68.6	125930	80.9	60509	
High school	16.2	41735	18.3	33661	10.8	8074	
>High school	11.7	30268	13.1	24057	8.3	6211	
Maternal occupation							<0.001
Farm work/housework	66.1	171389	63	115648	73.7	55741	

Routine job	22.9	59233	26.3	48171	14.6	11062	
Others	11	28509	10.7	19625	11.7	8884	
Parity (>1 pregnancy)	25	64892	17.7	32578	42.5	32314	<0.001
Current smoking (yes)	0.18	470	0.17	306	0.22	164	0.008
Current alcohol drinking (yes)	0.5	1287	0.53	975	0.41	312	<0.001
Preterm birth (yes)	4.01	10315	3.87	7111	4.34	3204	<0.001
Caesarean-section (yes)	63.3	162343	70.2	128690	45.9	33653	<0.001
Infant sex, %male	52.3	134492	51.9	95348	53.2	39144	<0.001
	Mean	SD	Mean	SD	Mean	SD	
Gestational weeks, wk	39.2	1.55	39.1	1.43	39.3	1.79	<0.001
Infant birth weight, g	3319.7	451.4	3320.5	442.4	3317.7	473.2	0.145

Difference in categorical variables was examined by Chi-square test. ANOVA was used to examine difference in continuous variables.

In this table, to get the follow-up information for the children between 1-3 years old in the present cohort, we selected mother-child pairs who were recruited before June 2010 and followed up to June 2013 (≥3 years old for children recruited in 2010 or before).

Table 4 Maternal characteristics for children with and without followed-up information between 4-7 year old (pre-school stage)

	Overall (n=136 997)		Children with follow-up information between 4-7 years old (n=94 426)		Children without follow-up information between 4-7 years old (n=42 571)		*P*-value
	Percent	N	Percent	N	Percent	N	
Maternal age at pregnancy, y							<0.001
≤25	60.4	82 660	61.3	57 883	58.3	24 777	
26-30	26.8	36 707	26.3	24 790	28	11 917	
31-35	11.7	16 042	11.4	10 758	12.4	5 284	
≥36	1.1	1 508	1.01	951	1.31	557	
Maternal BMI, kg/m2							<0.001
<18.5	17.8	24 039	18.7	17 470	15.7	6 569	
18.5-24.9	73.8	99 813	74.7	69 762	71.8	30 051	
25-29.9	7.58	10 262	6	5 603	11.1	4 659	
≥30	0.89	1 198	0.65	612	1.4	586	
Recruiting time point							<0.001
First trimester or before	79.5	108 886	84.9	80 081	67.7	28 805	
Second trimester	15.3	20 964	13.4	12 633	19.6	8 331	
Third trimester	5.16	7 070	1.77	1 666	12.7	5 404	
Menarcheal age, y							<0.001
<14	14.2	19 325	14	13 120	14.6	6 205	
14-15	59	80 510	58.6	55 101	60	25 409	
>15	26.8	36 605	27.5	25 842	25.4	10 763	
Maternal education							<0.001
<High school	76.8	104 851	75.8	71 549	78.8	33 302	
high school	16.8	22 933	17.6	16 599	15	6 334	
>high school	6.46	8 830	6.57	6 201	6.22	2 629	
Maternal occupation							<0.001

Farm work/housework	68.2	93 284	67.5	63 711	69.6	29 573	
Routine job	24.9	34 068	26	24 520	22.5	9 548	
others	6.92	9 468	6.48	6 114	7.9	3 354	
Parity (>1 pregnancy)	19.9	27 276	17.7	16 670	24.9	10 606	<0.001
Current smoking (yes)	0.15	198	0.15	140	0.14	58	0.57
Current alcohol drinking (yes)	0.19	258	0.17	163	0.23	95	0.05
Preterm birth (yes)	3.98	5 358	3.84	3 620	4.28	1 738	<0.001
Caesarean-section (yes)	69.8	93 859	72.6	68 338	63.4	25 521	<0.001
Infant sex, %male	51.8	69 852	51.8	48 850	52	21 002	<0.001
	Mean	SD	Mean	SD	Mean	SD	
Gestational weeks, wk	39.1	1.5	39.1	1.4	39.2	1.7	<0.001
Infant birth weight, g	3308.4	444.5	3308.1	434.9	3309.1	466.1	0.713

Difference in categorical variables was examined by Chi-square test. ANOVA was used to examine difference in continuous variables.

In this table, to get the follow-up information for the children between 4-7 years old in the present cohort, we selected mother-child pairs who were recruited before June 2006 and followed up to June 2013 (≥7 years old for children recruited in 2006 or before).

Figure legends

Figure 1 Location of the Jiaxing area in China and 7 counties within Jiaxing in a map

Figure 2 Flow chart of Jiaxing Birth Cohort

Figure 1 Location of the Jiaxing area in China and 7 counties within Jiaxing in a map 126x173mm (300 x 300 DPI)

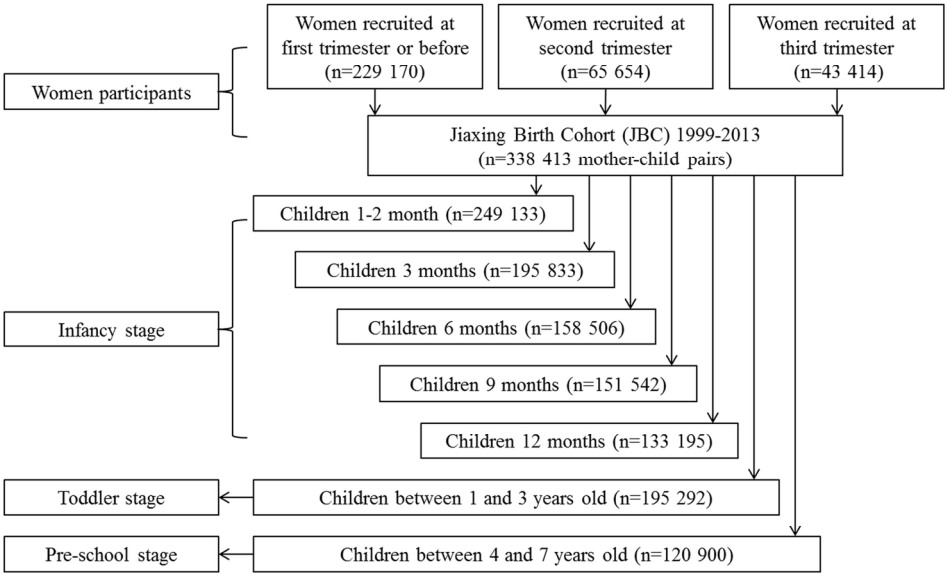

Figure 2 Flow chart of Jiaxing Birth Cohort
156x101mm (300 x 300 DPI)