Population-based longitudinal study showed that children born small for gestational age faced a higher risk of hospitalisation during early childhood

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Short title: Small for gestational age and hospitalisation

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Abstract

Aim

We examined the effects of being born small for gestational age (SGA) on the risk of being hospitalised for common diseases during childhood.

Methods

This Japanese nationwide, population-based longitudinal survey followed babies born before 42 weeks of gestation from 10-17 January and 10-17 July 2001, using data from the Government's Longitudinal Survey of Babies in the 21st Century. Our study followed 41,268 children until 5.5 years of age: 39,107 full-term (8.7% SGA) and 2,161 preterm (15.5% SGA). We evaluated the relationship between SGA status and hospitalisation using their history of hospitalisation for common diseases and comparing full-term or preterm births. Logistic regression analysis, adjusted for potential confounders, estimated the odds ratios (ORs) and 95% confidence intervals (CIs).

Results

The full-term and preterm children who were born SGA were more likely to be hospitalised during infancy and early childhood than those born non SGA. The ORs for hospitalisation from 6-18 months of age were 1.23 (95% CI 1.10-1.37) for full-term and

1.67 (95% CI 1.23-2.25) for preterm subjects. Higher risks of hospitalisation due to bronchitis, pneumonia, bronchial asthma and diarrhoea were also observed.

Conclusion

Being born SGA was associated with all-cause and cause-specific hospitalisation in early childhood, particularly for term infants.

Keywords:

Common childhood diseases, hospitalisation, longitudinal study, preterm infants, small for gestational age infants,

Key Notes

- This nationwide survey followed 41,268 babies born before 42 weeks of gestation until they were 5.5 years to explore the effect of being born small for gestational age (SGA) on hospitalisation.
- It found that that full-term and preterm SGA children were more likely to be hospitalised in early childhood than those not born SGA.
- SGA birth was associated with all-cause and cause-specific hospitalisation in early childhood, particularly for term infants.

INTRODUCTION

Small for gestational age (SGA) infants have a lower birth weight than babies of the same gestational age (1) and are known to be at increased risk of morbidity and mortality during childhood (2). Moreover, SGA infants are at increased risk of cerebral palsy or other unfavourable neurological developments during childhood, such as impaired speech or behavioural problems (3). Previous studies have suggested that SGA infants can subsequently develop glucose intolerance, such as type 2 diabetes and gestational diabetes, and cardiovascular disease, hypertension, or obesity in adulthood (4, 5). This well known as the fetal origin hypothesis of adult morbidities (6).

Previous studies have rarely differentiated between the health effects of SGA birth on full-term and preterm infants. Indeed, earlier studies have showed the health effects of SGA on hospital admission for respiratory issues in childhood (7) or for various diseases from childhood to early adulthood (8). However, they focused on limited health outcomes or limited gestational ages and did not examine the effects between full-term and preterm infants. Full-term SGA births outnumber preterm SGA births and this means that it is important, from a public health perspective, to explore possible health effects of being born SGA among full-term and preterm SGA infants. Despite that, attempts to examine the effects separately by full-term or preterm infants have been few (7, 8).

This study examined the effects of being born as SGA on the risk of hospital admission due to common childhood diseases, using a large-scale nationwide representative longitudinal survey that sent questionnaires to more than 50,000 people all over Japan. We separated SGA infants into full-term and preterm births throughout the analyses.

METHODS

Participants

The Ministry of Health, Labour and Welfare of Japan has conducted a nationally representative longitudinal survey to follow babies born throughout the country during 10-17 January and 10-17 July 2001 (9,10). The survey is known as the Longitudinal Survey of Babies in the 21st Century and approximately one in every 20 babies born in Japan during 2001 were enrolled in the survey. A baseline questionnaire was sent to all families when the surveyed newborns infants were six months old (n=53,575) and 47,015 (88%) were returned. Follow-up questionnaires were sent to all participants who initially responded each year: (at 18, 30, 42, 54 and 66 months, seven, eight, nine, 10, 11, 12, 13, 14 and 15 years. The 14th survey was completed in 2015. Information obtained from the questionnaires has also been linked to birth record data from Japanese vital statistics,

including gestational age, weight, sex, parity, parental age and whether the infant was a singleton, twin or other multiple birth.

From the 47,015 participants, we excluded data for children without information related to birth weight (n=14) or gestational week (n=24). We defined the SGA status of the newborn infants using Japanese standards for birth weight according to pregnancy duration (3). These do not include information for infants born after 42 weeks of gestation age and 414 born after this age were excluded. We also excluded 5,295 large for gestational age babies, whose birth weight was higher than 10% of the population according to pregnancy duration. Following exclusions we compared 41,268 children who were born at weights that were appropriate for gestational age (AGA) infants and SGA. The majority were AGA (n=37,530) and the remainder were SGA (n=3,738) (Table 1).

We defined SGA babies as those whose birth weight was less than 10% of the population according to pregnancy duration following earlier studies (3). To define the SGA status for each child, we used birth weight percentiles for each gestational week and day based on the Japanese standards published by the Committee for Newborns of the Japanese Pediatric Society (3). Birth weight and gestational age data were collected from birth records.

Hospital admissions

To examine the health effects of SGA birth, we used the children's history of overnight hospitalisation up to 66 months (5.5 years) of age as an indicator of health status. The survey asked for information about whether or not the child had been hospitalised during the preceding 12 months for any reason or for several common diseases. The same question was asked by every survey from the second survey at the age of 18 months to the sixth survey at the age of 66 months.

For the present study, we examined whether there was at least one hospitalisation for any cause or specific causes during infancy (6–18 months of age) and during early childhood including infancy (6–66 months of age). The reason of the overlap of the study period was that we attempted to evaluate the health effect of SGA during the whole period of early childhood with the latter category of the outcome. We specifically examined hospitalisation for some specific diseases, namely bronchitis and pneumonia, bronchial asthma and diarrhoea, because these diseases were the common causes of hospitalisation among young children in Japan (11).

Statistical analysis

First we examined the demographic characteristics differentiated by the SGA status and then we compared the demographic characteristics between those who were included in the analysis and those who were lost to follow up at 18 or 66 months of age. We then applied logistic regression analysis to evaluate the relationships between the SGA status and hospitalisation because of any cause or specific causes in each interval. We adjusted for child and parental factors in the model and estimated the adjusted odds ratio (OR) and 95% confidence intervals (CI) for each outcome. Throughout the analyses, we separated the participants by full-term births or preterm births, defined as less than 37 weeks, and used AGA births as the reference group.

Child factors included sex (dichotomous), singleton or multiple birth (dichotomous), gestational age (continuous), and parity (0 or >1, dichotomous). Parental factors included maternal age at delivery (continuous), postnatal maternal smoking status (non-smoker; and smoker, dichotomous), and maternal educational attainment (categorical). The birth record for each child contained data on sex, gestational age, parity, singleton birth or not and maternal age at delivery. Postnatal maternal smoking status was ascertained during the first survey. Maternal educational attainment was used an indicator of socioeconomic status and obtained from the second survey when the infants were 18 months of age. We reclassified the original eight educational categories into three, as follows: university for

four years or more; junior college for two years or vocational school and high school, junior high school and other. These potential confounders were selected based on earlier studies or prior knowledge of the association between SGA status and health outcomes (3). Cases with missing data were excluded and we only conducted our analysis with complete cases.

For the sensitivity analyses, we excluded 856 children who had visited clinics or hospitals for congenital diseases between 6-18 months of age and repeated the analyses for hospitalisation between 6-18 months to remove possible confounding bias. We did so because children who were born with congenital diseases might have been born SGA and tended to be hospitalised. The information was also queried in the survey question. We had no information related to visits made before six months of age and the specific diseases before that age.

All CIs were calculated at the 95% level. The study used Stata software, version 14/SE (Stata Corp, Texas, USA). This study was approved by the Okayama University Graduate School of Medicine, Dentistry and Pharmaceutical Sciences Institutional Review Board (number 1506-073).

RESULTS

The baseline characteristics of the eligible children and their parents according to SGA status are presented in Table 1. This shows that 3,403/39,107 (8.7%) of the term children were born SGA, as were 335/2,161 (15.5%) of the preterm children. SGA children were more likely to be multiple births and preterm births and to have smoking mothers compared to AGA children. Eligible children lost to follow up at 18 or 66 months of age were more likely to be multiple births, preterm births and SGA infants and to have mothers who were young, smokers and had lower education levels than those included in the analysis at 18 or 66 months of age (Tables S1 and S2).

In Table 2, we present the number of cases hospitalised for any cause and the adjusted ORs for the association between SGA status and hospitalisation, divided into full-term or preterm births. The SGA children were more likely to be hospitalised after full-term and preterm births compared with AGA children during infancy and early childhood. The ORs were higher among preterm births. For example, adjusted ORs for hospitalisation for 6–18 months of age were 1.23 (95% CI 1.10-1.37) for full-term births and 1.67 (1.23-2.25) for preterm births.

We present the results related to hospitalisation because of specific causes in Table 3. Although the results did not reach statistical significance, the elevated risks for bronchitis, pneumonia and bronchial asthma among term infants were restricted to infancy. By

contrast, the elevated risks for diarrhoea among term infants were observed during both infancy and early childhood. Possibly because of the small number of cases, the results were unstable for preterm births. Even when we excluded the 856 children who had visited clinics or hospitals for congenital diseases from 6–18 months of age, the results were attenuated slightly, but they did not change substantially (Table 4).

DISCUSSION

This study examined the relation between SGA birth and the risk of hospitalisation in early childhood using data from a large, nationwide, population-based longitudinal survey that started in 2001 in Japan. Compared with AGA infants, SGA infants had a higher risk of hospitalisation for any cause in both term and preterm infants and a higher risk of hospitalisation because of bronchitis, pneumonia, bronchial asthma and diarrhoea in term infants.

SGA infants were at higher risk of all-cause hospitalisation during early childhood in both term and preterm infants. SGA infants are characterised by altered physiological and metabolic functions during the fetal period because of intrauterine environmental aggravation. These altered functions might successively affect the health status of SGA infants during childhood, as reported in the present study, as well as during adulthood

(4,5). An earlier study demonstrated that SGA infants who presented with substantial weight gain up to the age of 20 months had 65% fewer subsequent hospital admissions than other SGA children (12). Another study reported that unfavourable catch-up among SGA infants could partly explain the elevated risk of hospitalisation (7,8). Moreover, the ORs in Table 2 were higher among preterm infants than among term infants during infancy, as well as during early childhood, which shows that SGA status had a stronger effect on the health of preterm infants. Preterm SGA infants may have more pathological conditions that cause SGA or fail to catch up more frequently than term SGA infants. This means that the preterm SGA infants were probably the most vulnerable patients in our study cohort.

When we examined specific causes, we found that elevated risks for bronchitis, pneumonia and bronchial asthma were only observed among term infants, and particularly during infancy, but this finding was not statistically significant. The small number of cases among preterm infants would partly explain the lack of findings for them. The elevated risk of bronchitis and pneumonia among term infants was consistent with the results of an earlier study, which revealed that SGA was independently associated with an increased risk of emergency respiratory hospital admissions (7). The finding for bronchial asthma was also consistent with those of a previous study that

reported that SGA status was associated with asthma hospital admissions (13). The present findings, and those of earlier studies, demonstrate that term SGA infants have vulnerable respiratory functions, particularly during infancy.

In contrast, we observed a higher risk for diarrhoea in term born subjects, both in infancy and during early childhood. Although one study described an increased risk of gastrointestinal mortality among SGA infants (14), no reports have described the effects of SGA birth on gastrointestinal infectious diseases. We do not know the exact mechanism by which SGA births are at increased risk of gastrointestinal infectious disease in childhood. However, impaired intestinal growth and function, caused by altered cell proliferation - apoptosis balance among intrauterine growth retarded mammals - might partly explain this finding (15). For example, Romain et al (16) demonstrated that intrauterine growth restriction in piglets affected intestinal weight and structure and enhanced the number of adherent bacteria. This lead to an imbalance in proliferation-apoptosis homeostasis and subsequently decreased the exchange of the intestinal surface in the early neonatal period among the affected piglets. Although it is not clear whether this impaired intestinal function continues into childhood, this mechanism may contribute to the findings. The present findings indicate that the SGA condition affects digestive as well as respiratory functions.

This study had several strengths, including the fact that the participants were from a large, nationwide, representative survey. The survey provided repetitive data collected at various ages and this provided a broad range of information related to children through infancy and childhood and allowed us to adjust for important, potential confounding factors. We were also able to examine the effects of SGA birth across the full range of gestational age groups. The population of Japan is covered by universal health insurance and this means that the quality of medical care was regarded as homogeneous among the participants.

This study also had several limitations. First, the subjects' health status was based on parental reports with no verification of data using medical records. This method was potentially affected by recall bias, which might have move effect estimates toward the null position if misclassification was non-differential. Moreover, recall of diagnoses may be difficult and some parents could not differentiate bronchitis and pneumonia and bronchial asthma, especially during infancy. However, some reports have described that parental answers to questionnaire related to episodes of acute illness including respiratory infections and healthcare correlate well with medical records (17,18).

Second, we lacked information about the health status of the infants at birth, such as their Apgar scores and congenital malformations. Therefore, we were unable to control

for this potential confounding factor, although we observed similar findings when we excluded children who had visited clinics or hospitals for congenital diseases at 6–18 months of age (Table 4). Moreover, we controlled for maternal smoking after birth but not for maternal smoking status during pregnancy, which might leave some residual confounding.

Third, several participants were lost to follow up during the study period. As shown in Tables S1 and S2, children lost to follow up were more likely to be born SGA and to have young mothers, mothers who smoked, and parents with lower educational levels than those followed up. Losses were more common among SGA subjects and they had a higher risk of health problems due to, for example, young mothers and mothers who smoked. Therefore, this selection bias would have led to us underestimating the negative effects of SGA on health outcomes.

Despite the limitations of our study, the present findings have important clinical implications. Although earlier studies did not differentiate between term and preterm subjects when examining the health effects of SGA birth, our study showed elevated risks of SGA birth for both term and preterm birth, with particular issues for term born infants. Considering that there were more than 10 times as many term SGA infants as preterm SGA infants in our study (3,403 versus 335), the public health effects of term SGA birth

are expected to outweigh those of preterm SGA infants. Furthermore, SGA birth has also been shown to increase the risk of other health outcomes (8), as well as impaired growth or neurodevelopment (3). Consequently, long-term follow up and support are needed for both term and preterm SGA infants

CONCLUSION

SGA birth was associated with all-cause and cause-specific hospitalisation in early childhood, in particular for term infants. The number of term SGA births is greater than that of preterm SGA births. Therefore, these findings present important implications for public health and healthcare services.

FINANCE

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CONFLICTS OF INTEREST

The authors have no conflicts of interest to declare.

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Abbreviations:

AGA, appropriate for gestational age; CI, confidence interval; SGA, small for gestational age; OR, odds ratio

References

1. Simmons R. Abnormalities of Fetal Growth. In: Gleason CA, Devaskar SU, Avery ME, eds. *Avery's diseases of the newborn*. 9th ed. Philadelphia, Pa. ; London: Elsevier Saunders, 2011.
2. Lackman F, Capewell V, Richardson B, daSilva O, Gagnon R. The risks of spontaneous preterm delivery and perinatal mortality in relation to size at birth according to fetal versus neonatal growth standards. *Am J Obstet Gynecol* 2001; 184 5:946-53.
3. Takeuchi A, Yorifuji T, Takahashi K, Nakamura M, Kageyama M, Kubo T, et al. *Brain Dev* 2016; 38 6:529-37.
4. Barker DJ, Eriksson JG, Forsen T, Osmond C. Fetal origins of adult disease: strength of effects and biological basis. *Int J Epidemiol* 2002; 31 6:1235-9.
5. Spence D, Alderdice FA, Stewart MC, Halliday HL, Bell AH. Does intrauterine growth 2 restriction affect quality of life in adulthood? *Arch Dis Child* 2007; 92 8:700-3.
6. Gillman MW. Developmental origins of health and disease. *N Engl J Med* 2005; 353 17:1848-50.
7. Paranjothy S, Dunstan F, Watkins WJ, Hyatt M, Demmler JC, Lyons RA, et al. Gestational age, birth weight, and risk of respiratory hospital admission in childhood. *Pediatrics* 2013; 132 6:e1562-9.
8. à Rogvi R, Forman JL, Greisen G. Prematurity, smallness-for-gestational age and later hospital admissions: a nation-wide registry study. *Early Hum Dev* 2015; 91 5:299-306.
9. Kato T, Yorifuji T, Inoue S, Yamakawa M, Doi H, Kawachi I. Associations of preterm births with child health and development: Japanese population-based study. *J Pediatr* 2013; 163 6:1578-84 e4.
10. Yamakawa M, Yorifuji T, Inoue S, Kato T, Doi H. Breastfeeding and obesity among schoolchildren: a nationwide longitudinal survey in Japan. *JAMA Pediatr* 2013; 167 10:919-25.
11. Ministry of Health Labour and Welfare in Japan. Patient Survey. 2014
12. Victora CG, Barros FC, Horta BL, Martorell R. Short-term benefits of catch-up growth for small-for-gestational-age infants. *Int J Epidemiol* 2001; 30 6:1325-30.
13. Gessner BD, Chimonas MA. Asthma is associated with preterm birth but not with small for gestational age status among a population-based cohort of Medicaid-enrolled children <10 years of age. *Thorax* 2007; 62 3:231-6.
14. Selling KE, Carstensen J, Finnstrom O, Josefsson A, Sydsjo G. Hospitalizations in adolescence and early adulthood among Swedish men and women born

preterm or small for gestational age. *Epidemiology* 2008; 19 1:63-70.

15. Wang X, Lin G, Liu C, Feng C, Zhou H, Wang T, et al. Temporal proteomic analysis reveals defects in small-intestinal development of porcine fetuses with intrauterine growth restriction. *J Nutr Biochem* 2014; 25 7:785-95.
16. Romain D'Inca, Maela Kloareg, Christèle Gras-Le Guen, Isabelle Le Huërou-Luron. Intrauterine growth restriction modifies the developmental pattern of intestinal structure, transcriptomic profile, and bacterial colonization in neonatal pigs. *J Nutr* 2010; 140 :925-31.
17. D'Souza-Vazirani D, Minkovitz CS, Strobino DM. Validity of maternal report of acute health care use for children younger than 3 years. *Arch Pediatr Adolesc Med* 2005; 159 2:167-72.
18. Heli V. Brandão, Graciete O.Vieira, Tatiana O.Vieira, Álvaro A. Cruz, Armênio C Guimarães, Carlos teles, et al. Acute viral bronchiolitis and risk of asthma in schoolchildren: analysis of a Brazikian newborn cohort. *J Pediatr (Rio J)* 2017; 93 3:223-29.

Table 1. Demographic characteristics of eligible children (n=41,268)

	AGA (N=37,530)	SGA (N=3,738)	*P* value§
Characteristics of children			
Sex, *n* (%)*			
Boys	19467 (51.9)	1958 (52.4)	0.55
Girls	18063 (48.1)	1780 (47.6)	
Singleton or multiple birth*			
Singleton, *n* (%)	36876 (98.3)	3432 (91.8)	<0.001
Multiple, *n* (%)	654 (1.7)	306 (8.2)	
Mean gestational age, weeks (SD)*	38.9 (1.6)	38.7 (2)	<0.001
Term birth, *n* (%)*	35704 (95.1)	3403 (91)	<0.001
Preterm birth, *n* (%)*	1826 (4.9)	335 (9)	
Less than 28 gestational weeks	55 (3)	11 (3.3)	
28 to 31 gestational weeks	140 (7.7)	49 (14.6)	
32 to 33 gestational weeks	168 (9.2)	37 (11)	
34 to 36 gestational weeks	1463 (80.1)	238 (71)	
Parity, *n* (%)*			
0	18174 (48.4)	1840 (49.2)	0.35
≥ 1	19356 (51.6)	1898 (50.8)	
Parent characteristics			
Mean maternal age at delivery, years (SD)*	29.9 (4.5)	30 (4.5)	0.13
Postnatal maternal smoking status, *n* (%)†			
Non-smoker	30860 (82.7)	2900 (78.1)	<0.001
Smoker	6461 (17.3)	812 (21.9)	
Maternal educational attainment, *n* (%)‡			
University or higher	4895 (14)	453 (13.2)	0.09
Junior college	14463 (41.4)	1393 (40.5)	
Less than or equal to high school	15562 (44.6)	1598 (46.4)	

AGA, appropriate for gestational age; SD, standard deviation; SGA, small for gestational age

* Obtained from the birth record

† Obtained from the first survey (age of 6 months)

‡ Obtained from the second survey (age of 18 months)

§ Differences between Non-SGA and SGA were tested using the chi-squared test or *t*-test.

There were 235 cases missing on maternal smoking and 2904 cases missing on maternal educational attainment.

Table 2. Adjusted* ORs for associations between SGA status and hospitalizations from all causes

	Term births		Preterm births	
	AGA	SGA	AGA	SGA
Between 6 and 18 months				
N*case*/*N* (%)	4053 / 33461 (12.1)	462 / 3157 (14.6)	277 / 1661 (16.7)	78 / 309 (25.2)
OR (95% CI)	1 (ref.)	1.23 (1.1 - 1.37)	1 (ref.)	1.67 (1.23 - 2.25)
Between 6 and 66 months				
N*case*/*N* (%)	7532 / 27415 (27.5)	750 / 2545 (29.5)	457 / 1319 (34.6)	108 / 238 (45.4)
OR (95% CI)	1 (ref.)	1.1 (1 - 1.2)	1 (ref.)	1.57 (1.17 - 2.1)

AGA, appropriate for gestational age; CI, confidence interval; OR, odds ratio; SGA, small for gestational age

* Adjusted for child factors (sex, singleton or not, gestational age, and parity) as well as parental factors (maternal age at delivery, postnatal maternal smoking status, and maternal educational attainment).

Table 3. Adjusted* ORs for associations between SGA status and hospitalizations for bronchitis/pneumonia, bronchial asthma, and diarrhea

	Term births		Preterm births	
	AGA	SGA	AGA	SGA
Bronchitis/pneumonia				
Between 6 and 18 months				
N*case*/*N* (%)	2179 / 33461 (6.5)	236 / 3157 (7.5)	166 / 1661 (10)	34 / 309 (11)
OR (95% CI)	1 (ref.)	1.14 (0.99 - 1.32)	1 (ref.)	1.07 (0.71 - 1.61)
Between 6 and 66 months				
N*case*/*N* (%)	3913 / 27415 (14.3)	378 / 2545 (14.9)	262 / 1319 (19.9)	53 / 238 (22.3)
OR (95% CI)	1 (ref.)	1.05 (0.93 - 1.17)	1 (ref.)	1.14 (0.8 - 1.62)
Bronchial asthma				
Between 6 and 18 months				
N*case*/*N* (%)	274 / 33461 (0.8)	39 / 3157 (1.2)	24 / 1661 (1.4)	6 / 309 (1.9)
OR (95% CI)	1 (ref.)	1.39 (0.98 - 1.97)	1 (ref.)	1.6 (0.63 - 4.07)
Between 6 and 66 months				
N*case*/*N* (%)	791 / 27415 (2.9)	87 / 2545 (3.4)	70 / 1319 (5.3)	11 / 238 (4.6)
OR (95% CI)	1 (ref.)	1.13 (0.9 - 1.42)	1 (ref.)	0.96 (0.49 - 1.87)
Diarrhea				
Between 6 and 18 months				
N*case*/*N* (%)	416 / 33461 (1.2)	59 / 3157 (1.9)	27 / 1661 (1.6)	5 / 309 (1.6)
OR (95% CI)	1 (ref.)	1.42 (1.07 - 1.89)	1 (ref.)	0.87 (0.33 - 2.33)
Between 6 and 66 months				
N*case*/*N* (%)	1164 / 27415 (4.2)	133 / 2545 (5.2)	60 / 1319 (4.5)	15 / 238 (6.3)
OR (95% CI)	1 (ref.)	1.21 (1.01 - 1.46)	1 (ref.)	1.38 (0.76 - 2.51)

AGA, appropriate for gestational age; CI, confidence interval; OR, odds ratio; SGA, small for gestational age

* Adjusted for child factors (sex, singleton or not, gestational age, and parity) as well as parental factors (maternal age at delivery, postnatal maternal smoking status, and maternal educational attainment).

Table 4. Adjusted* ORs for associations between SGA status and hospitalizations from all causes excluding children with congenital disease

	Term births		Preterm births	
	AGA	SGA	AGA	SGA
Between 6 and 18 months				
All causes				
N*case*/*N*(%)	3696 / 32799 (11.3)	407 / 3055 (13.3)	240 / 1593 (15.1)	59 / 285 (20.7)
OR (95% CI)	1 (ref.)	1.19 (1.06 - 1.33)	1 (ref.)	1.47 (1.05 - 2.04)
Bronchitis/pneumonia				
N*case*/*N*(%)	2103 / 32799 (6.4)	219 / 3055 (7.2)	156 / 1593 (9.8)	30 / 285 (10.5)
OR (95% CI)	1 (ref.)	1.11 (0.96 - 1.28)	1 (ref.)	1.05 (0.68 - 1.6)
Bronchial asthma				
N*case*/*N*(%)	269 / 32799 (0.8)	36 / 3055 (1.2)	22 / 1593 (1.4)	4 / 285 (1.4)
OR (95% CI)	1 (ref.)	1.32 (0.92 - 1.89)	1 (ref.)	1.21 (0.4 - 3.65)
Diarrhea				
N*case*/*N*(%)	403 / 32799 (1.2)	55 / 3055 (1.8)	24 / 1593 (1.5)	5 / 285 (1.8)
OR (95% CI)	1 (ref.)	1.37 (1.03 - 1.84)	1 (ref.)	1.09 (0.4 - 2.93)

AGA, appropriate for gestational age; CI, confidence interval; OR, odds ratio; SGA, small for gestational age

* Adjusted for child factors (sex, singleton or not, gestational age, and parity) as well as parental factors (maternal age at delivery, maternal postnatal smoking status, and maternal educational attainment).