

Is overweight a risk factor for wheezing in pre-school children? A study in 14 Brazilian communities

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Abstract

Objective: To evaluate the association between overweight and wheezing in pre-school children in 14 small Brazilian communities.

Methods: Cross-sectional epidemiological study, conducted between 2001 and 2002. A sample of 3453 children under 5 years of age was taken from nine communities in the state of Bahia and five in the state of São Paulo. Data on housing, family and children were obtained by applying structured questionnaires *in loco*. Weight and height for each child were also measured. The association between wheezing and overweight was assessed by unconditional logistic multivariate regression models.

Results: Overweight children had a greater frequency of wheezing and an odds ratio of 2.57 (95% confidence interval 1.51–4.37) was estimated after controlling for several potential confounding variables. The magnitude of the risk was not affected by several different model specifications.

Conclusion: Excess weight is associated with increased risk for wheezing in this population of children below 5 years of age.

Keywords
Pre-school children
Wheezing
Obesity
Risk assessment

An association between obesity and the development of asthma in children and adults has been reported recently in several studies^{1–4}. However, whether obesity predisposes to bronchial hyper-responsiveness in pre-school children has not been clarified. Wheezing is a clinical manifestation more characteristic of asthma⁵ and pre-school children with wheezing have an elevated risk for the development of asthma later in life⁶. Given this, the detection of an association between overweight and wheezing in pre-school children may indicate that the influence of obesity on the risk for asthma may occur quite early in somatic development. Such information would be of use in the design of preventive strategies to decrease the risk for the development of asthma, by defining the period where weight control should be implemented.

The present study reports a significant association between wheezing and overweight in a large sample of pre-school children living in small towns of the states of Bahia and São Paulo, Brazil.

Methods

The study was approved by the Ethics Committee of the School of Public Health of the University of São Paulo. Participant families were instructed about the objectives of the study and in all cases gave informed consent after such information had been obtained.

Selection of study locations

The present investigation is part of a larger study that focused on the living conditions, nutrition and health of children between 0 and 5 years of age living in small towns in the states of Bahia and São Paulo, Brazil.

The communities were selected based on the following criteria: high urbanisation rate, small territory extent (<500 km²), small population (<15 000 inhabitants) and an adequate representation of different geographic profiles, in order to reflect some of the economic and social diversity of Brazil.

The study was conducted between March 1999 and March 2000 in Bahia, and during November and December 2001 in São Paulo. In Bahia, the towns of São Felix, Itiruçu, Cipó, Milagres, Acajutiba, Gongogi, Santa

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Inês, Presidente Dutra and Serrolândia were studied, whereas Bady Bassit, Bofete, Jaborandi, Morungaba and Riversul were studied in São Paulo.

Sampling strategy

As mentioned above, the present investigation is part of a larger study which focused on more general conditions of health and socio-economic variables in children, with more emphasis on malnutrition. In Bahia, the determination of sample size took into account the prevalence of stunting in the Northeastern region of Brazil⁷, whereas in São Paulo the sample size was computed using as reference the predicted prevalence of stunting for each community based on the model proposed by Benício and Monteiro⁸. After selecting the communities, children were enrolled in the study using the following approaches. In Bahia, a two-stage sampling was employed, considering the home as the primary unit and the child as the secondary unit. In São Paulo, the strategy was to select the sample in a single-stage approach, i.e. obtaining data on all children under 5 years of age in selected homes. Table 1 presents the number of homes evaluated for each community and the corresponding sample fraction.

Data acquisition

Data on housing, socio-economic conditions and maternal and child health were obtained by trained personnel, who applied structured questionnaires to mothers. The interviewer was also trained to measure height and weight according to World Health Organization (WHO) recommendations⁹. Anthropometric measurements were determined twice, using adequate instruments (electronic scale and stadiometer), and the difference between these two measurements was kept below 0.1 cm and 100 g for height and weight, respectively¹⁰.

Table 1 Number of houses selected and the fraction of houses in rural and urban zones in each community

Town	No. of houses selected in rural zone	Sample fraction in rural zone	No. of houses selected in urban zone	Sample fraction in urban zone
Acajutiba	101	1/5	463	1/5
Cipó	199	1/5	423	1/5
Gongogi	213	2/7	435	2/7
Itiruçu	239	2/9	455	2/9
Milagres	105	1/5	331	1/5
Presidente Dutra	345	1/4	370	1/4
Santa Inês	33	1/4	589	1/4
São Felix	262	1/4	450	1/4
Serrolândia	403	1/4	402	1/4
Bady Bassit	95	1/4	449	1/4
Bofete	173	1/3	398	1/3
Jaborandi	60	1/3	521	1/3
Morungaba	124	1/5	404	1/5
Riversul	289	1/3	487	1/3

Mothers were asked whether their children had presented any of the following clinical conditions in the previous 15 days: wheezing, upper respiratory tract infection (URTI), toothache, diarrhoea, fever, cough, prostration, or parasite elimination. In addition, information on previous hospital admissions (if present) was also recorded. Nutritional status was characterised using weight-for-height to define overweight and height-for-age to define malnutrition, using the National Center for Health Statistics¹¹ population as reference in accordance with WHO recommendations¹². A deviation from -2 Z-scores was selected as cut-off point. The software EpiInfo version 6.0 (Centers for Disease Control and Prevention, CDC) was employed for analysis of nutritional status.

Family income was expressed in terms of units of the minimum national salary (MNS), categorised in two levels: <0.5 MNS or ≥ 0.5 MNS.

Statistical analysis

Descriptive statistics of the measured variables were computed for each town. Thereafter unconditional logistic regression models were calculated, using as dependent variable a binary indicator for wheezing and different combinations of predictive variables: overweight, age, sex, URTI, fever, parasite elimination. In addition to health data, models also incorporated the following indicators of housing and socio-economic conditions: sleeping alone in the bed (yes/no), water treatment, availability of electricity and state. Statistical analysis was done with the aid of the software Stata version 7 (StataCorp).

Results

A total of 3453 children were studied, 2439 (70.6%) in Bahia and 1014 (29.4%) in São Paulo. A slight predominance of boys was observed (50.4%). The age distribution of the studied sample is shown in Fig. 1.

For the overall sample, the prevalence of malnutrition was 9.5% (95% confidence interval (CI) 8.4–10.6). Malnutrition was more frequent in Bahia (11.3%, 95% CI 9.9–12.8) than in São Paulo (5.2%, 95% CI 4.0–6.9).

The prevalence of overweight was 3.2% (95% CI 2.7–3.9). There were differences in the prevalence of overweight between states, being estimated as 1.8% (95% CI 1.3–2.4) in Bahia and 6.7% (95% CI 5.3–8.5) in São Paulo. Descriptive statistics of the collected data are presented in Table 2.

Table 3 depicts crude odds ratios for reporting of wheezing and each individual explanatory variable. Table 4 shows the odds ratios for reporting of wheezing and overweight (yes/no), both in the univariate model and in the multivariate model when all parameters depicted in Table 3 were considered simultaneously. This last model showed that overweight children had a greater frequency of reported wheezing, with an odds ratio of 2.57 (95% CI 1.51–4.37).

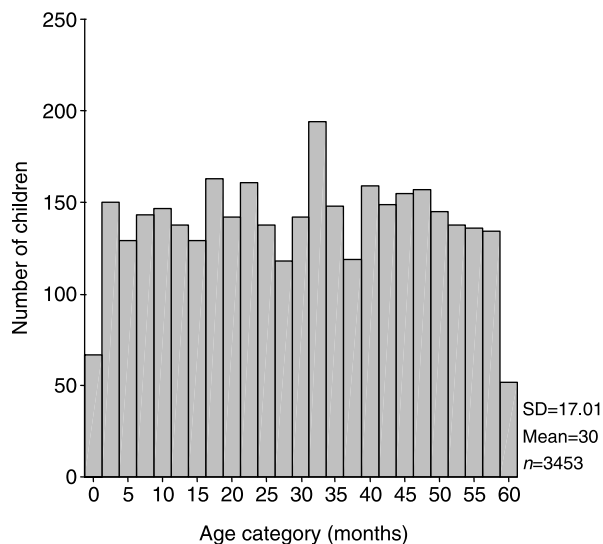


Fig. 1 Age distribution of the studied children from 14 towns in Brazil, 2000–2001 (SD – standard deviation)

Discussion

The results of the present study disclosed a significantly higher report of wheezing in overweight pre-school children. This association was robust and was not affected by the inclusion of different controlling variables. In fact, the magnitude of the odds ratio was not modified significantly by the inclusion of several explanatory variables (Table 4), indicating that overweight pre-school children were two times more prone to present wheezing in the 15 days before the questionnaire was applied. Moreover, the association between obesity and wheezing was insensitive to the criteria employed to define obesity. Using the criteria of Cole *et al.*¹³ and the CDC¹⁴, the coefficients relating obesity to wheezing remained virtually the same. This finding reinforces the relationship between these two conditions, i.e. risk for wheezing and obesity, each of which is exhibiting an increasing frequency in children^{15,16}.

Obesity is far from being a problem of developed countries. In fact, there is clear evidence of an increasing frequency of obesity in Brazilian children^{17–20}. In our study, obesity in pre-school children was also detected, being higher in São Paulo (6.7%).

Classically, programmes against obesity in children were motivated to prevent bone and joint problems, as well as cardiovascular, endocrine and psychological conditions²¹. The possible role of obesity in increasing the risk of asthma provides additional justification to prevent obesity in children. According to the present results, the prevention of obesity must be made at an early age if avoidance of asthma is the health endpoint.

The increased risk of obese children to present recent episodes of wheezing found in the present investigation – 2.57 (Table 4) – was also observed in previous studies despite the age groups and the criteria employed to define obesity being different. An investigation of 9357 children between 5 and 6 years of age living in rural communities in Germany disclosed a relative risk for asthma of 2.12 and 2.33 for overweight and obese children, respectively³. In the UK, a study of 14908 children revealed that obesity was associated with a risk for asthma of 1.28². In the USA, the risk for asthma in obese children ranged from 2.2²² to 8.1²³. Thus, although recognising that the present study focused on wheezing and not asthma, there is an apparent concordance between the findings observed in our population and those of earlier studies relating obesity to episodes of bronchial hyper-responsiveness in children, even at early ages as that of the present investigation.

The pathogenic mechanisms responsible for the increased frequency of asthma are not yet determined. Several mechanisms have been proposed, including reduction of airway size, different eating habits, sedentary life and changes in hormone levels²⁴. It is important to stress that wheezing in pre-school children may be caused by other pathological conditions, such as respiratory infections, intestinal parasites and gastro-oesophageal reflux²⁵. Other conditions such as exposure to tobacco

Table 2 Prevalence and 95% confidence interval (CI) of clinical conditions exhibited by the children enrolled in the study. Brazil, 2000–2001

Condition	Bahia		São Paulo		Total	
	Prevalence (%)	95% CI	Prevalence (%)	95% CI	Prevalence (%)	95% CI
Wheezing	18.0	16.5–19.7	22.9	20.3–25.7	19.4	18.1–20.9
Overweight	1.8	1.3–2.4	6.7	5.3–8.5	3.2	2.7–3.9
Fever	21.1	19.5–22.8	26.9	24.3–29.9	22.8	21.4–24.3
Cough	36.3	34.3–38.4	39.8	36.7–43.1	37.4	35.6–39.1
URTI	37.6	35.5–39.4	55.4	52.1–58.7	42.8	41.1–44.6
Loss of appetite	27.7	25.8–29.6	28.4	25.5–31.3	27.9	26.3–29.5
Prostration	17.1	15.5–18.7	22.4	19.8–25.3	18.6	17.3–20.1
Presence of parasites	5.6	4.5–6.7	4.0	2.9–5.5	5.2	4.4–6.0
Hospital admission in last 12 months	11.3	10.1–12.7	14.8	12.7–17.2	12.3	11.3–13.5

URTI – upper respiratory tract infection.

Table 3 Crude odds ratio (OR) and 95% confidence interval (CI) for the association between wheezing and each of the clinical, housing and socio-economic conditions in pre-school children from 14 towns in Brazil, 2000–2001

Variable	Category	OR	95% CI	P-value
Overweight	No	1.00		
	Yes	2.12	1.41–3.18	0.001
Sex	Female	1.00		
	Male	1.20	1.01–1.42	0.035
Fever	No	1.00		
	Yes	5.31	4.41–6.40	0.001
Cough	No	1.00		
	Yes	12.40	9.95–15.47	0.001
URTI	No	1.00		
	Yes	8.36	6.77–10.33	0.001
Prostration	No	1.00		
	Yes	4.61	3.79–5.60	0.001
Loss of appetite	No	1.00		
	Yes	4.28	3.57–5.12	0.001
Presence of parasites	No	1.00		
	Yes	2.51	1.81–3.48	0.001
Hospital admission in last 12 months	No	1.00		
	Yes	2.05	1.63–2.59	0.001
Age	24–60 months	1.00		
	<24 months	1.82	1.55–2.14	0.001
Financial income	<0.5 MNS	1.00		
	≥0.5 MNS	1.35	1.10–1.67	0.005
Sleeping alone in bed	No	1.00		
	Yes	1.16	0.98–1.38	0.082
Water treatment	No	1.00		
	Yes	1.20	1.01–1.40	0.084
Availability of electricity	No	1.00		
	Yes	0.98	0.73–1.32	0.905
State	Bahia	1.00		
	São Paulo	1.35	1.12–1.63	0.002

URTI – upper respiratory tract infection; MNS – minimum national salary.

smoke, low birth weight and low maternal age also increase risk for wheezing²⁶. However, in the age group evaluated in this study, the precise diagnosis of asthma is problematic. In fact, a recent study in São Paulo showed that 93% of pre-school children with episodes of wheezing were later in their lives diagnosed as having asthma²⁷. This finding indicates that wheezing is indeed a significant risk for asthma in the age group focused upon in our study²⁸.

In conclusion, obesity was shown to be a significant factor for wheezing in a large sample of pre-school children. Despite the limitations of a cross-sectional study and other restrictions already pointed out in our discussion, the large sample and maintenance of the magnitude and significance

Table 4 Odds ratio (OR) and 95% confidence interval (CI) for the association between overweight and wheezing, crude (Model 1) and adjusted (Model 2) for potential confounding variables, in pre-school children from Brazil, 2000–2001

Model	OR	95% CI	P-value
Model 1: Overweight	2.12	1.41–3.18	0.0003
Model 2: Overweight + explanatory variables*	2.57	1.51–4.37	0.0001

* Explanatory variables: sex, age in two categories, upper respiratory tract infection, loss of appetite, fever, parasites, hospital admission in last 12 months.

of the association across different model specifications are indicative that such association may be causal.

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