

Urbanisation, asthma and allergies

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Differences in asthma in urban and rural environments were first reported from Germany in 1965,¹ followed by many reports of higher rates of asthma symptoms in urban than rural environments around the world including Africa,² Asia^{3–5} and Papua New Guinea.⁶ Authors have suggested that wealth, lifestyle, housing and urban environmental exposures may contribute to increasing asthma prevalence. In relation to possible protective factors in the rural environment, studies have emerged on farming lifestyles in Westernised high-income countries, showing an inverse relationship between farm exposures early in life and asthma and rhinitis, but not eczema symptoms.^{7,8} The potential protective effect of microbial exposures from animals or unpasteurised milk on these diseases was highlighted. A recent review of these and other potential factors suggested a 'package' of factors may influence the lower prevalence in rural areas.⁹

In this issue of *Thorax*, two articles^{10,11} present new findings related to urbanisation in Latin America. Most of the readers of *Thorax* will not have visited the locations studied in these papers, as they are not on popular travel routes. However, they may represent the living circumstances of many of the world's children in low- and middle-income countries where the prevalence of asthma, rhinitis and eczema is mainly increasing.¹²

Rodríguez *et al*¹¹ undertook an ecological study in 59 communities in Esmeraldas Province, a humid, tropical, coastal region in Ecuador. This is one of the poorest and remotest areas of the country undergoing changes related to urbanisation over the last 20 years. From 2005 to 2008 all the 7–15-year-olds were studied within

the communities using parent completed questionnaires and reported community infrastructure. This study is robust with a high number of participants (n=4183) and a 95% response rate. Asthma was defined as a positive response to the question 'Has your child had wheeze in the chest in the last 12 months?', which I define as 'current asthma symptoms'. The overall prevalence of current asthma symptoms was 10.1%. Three of four urbanisation indices were significantly associated with current asthma symptom prevalence: the socioeconomic, lifestyle and summary urbanisation indices. Using multivariate analyses, infrastructure indicators explained 17.7% of variability, socioeconomic indicators 17.4% and lifestyle indicators 19.8%. Prevalence of current asthma symptoms decreased in communities with dirt roads compared with river access, and children living in cement-built rather than wood and bamboo houses; prevalence increased for communities with an electric grid connection, those with more than 15 shops compared with zero or one shops, houses with access to electricity, households with motor vehicles and adolescents consuming fizzy drinks.

Robinson *et al*¹⁰ in 2009–2010 studied 13–15-year-old adolescents living in two coastal regions of Peru: Pampas de San Juan de Miraflores, a 'peri-urban' shanty town in Lima with high population density centred on a heavy traffic route, and 23 rural villages with little traffic outside Tumbes city in northern Peru. Subjects were a sex-stratified sample in peri-urban Lima, and all the 13–15-year-olds in rural Tumbes. The adolescents completed their own questionnaires, they had some testing and concentrations of particulate matter of <2.5 µm diameter (PM_{2.5}) were measured in a subset of households. The number of subjects was relatively low (peri-urban Lima n=725, rural Tumbes (n=716)), as was the participation rate (78% overall). Significantly higher prevalence was found in peri-urban Lima than rural Tumbes for current symptoms of asthma (12% vs 3%), rhinitis (23% vs 12%) and eczema (12% vs 0.4%). The peri-urban to rural gradient

was also present for positive skin prick tests (56% vs 38%), personal history of cigarette smoking (7.4% vs 1.3%) and mean indoor PM_{2.5} (31 vs 13 µg/m³). Living in peri-urban Lima was associated with a 2.6-fold greater odds (95% CI 1.3 to 5.3) of current asthma symptoms in multivariable regression. It is difficult to interpret the slightly higher exhaled nitric oxide levels in peri-urban Lima, which the authors attribute to asthma and atopy. Differences were found between sites: in peri-urban Lima adolescents lived with fewer wood burning stoves and lower secondhand smoking exposure, but more active smoking, greater body mass index and were more likely to live in households with adequate sanitation, higher indoor and outdoor air pollution than in rural Tumbes.

The Ecuador study was an ecological study of a whole population aged 7–15 years, with questionnaires answered by parents, so direct comparisons of prevalence should not be made with the Peruvian study where adolescents self completed the questionnaires. The focus of the Ecuador study was to investigate factors of importance to asthma in rural communities undergoing transition, and some new aspects were explored such as dirt roads compared with power driven river transport. The Peruvian study compared symptom prevalence between urban and rural locations and sought risk factors, but this study was limited by smaller numbers. They studied not only asthma, but also symptoms of rhinitis and eczema, atopy and some other factors. The high prevalence of current symptoms of asthma in children from a peri-urban shanty town in Lima has been previously reported.¹³

These are among the first studies of rural versus urban environments in Latin America, and therefore are exciting and add useful information. The investigators have completed studies in environments that would be very challenging for researchers in high-income countries. The Ecuador study found the prevalence among the communities varied from 0% to 31.4%—almost the full range of prevalence values reported among the 233 centres in 97 countries in the global International Study of Asthma and Allergies in Childhood,¹⁴ consistent with that study's findings of extremes of prevalence among some low- and middle-income centres. The finding of such high prevalence among socioeconomically disadvantaged populations within Latin America has led to questioning of the relevance of



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the potential protective effect of hygiene in Latin America and supports the suggestion that low hygiene and poverty may be risk factors.¹⁵ Rodríguez *et al* in Ecuador have added to the discourse by examining the potential influence of urban lifestyle on rural societies related to the process of urbanisation (ie, the transition to urbanisation).

The study in Peru pursued the relationship between asthma and other 'atopic' conditions and atopy, and found greater atopy among peri-urban than rural children. However, the rate of atopy did not appear to explain the peri-urban to rural prevalence differences for current asthma symptoms. This is not surprising, as there is mounting evidence that not only are fewer than half the cases of asthma attributable to atopy,¹⁶ but that this proportion may be even lower in low- and middle-income countries.¹⁷ Moreover, similar observations have been found for rhinitis¹⁸ and eczema,¹⁹ questioning the extent to which these are atopic diseases.

The study in Peru is consistent with studies in other countries in showing higher rates of asthma in urban than rural environments, and adds to the observations of the symptoms of rhinitis and eczema, which also showed such a gradient. While the ideas stimulated by these papers are of real interest, can they be generalised to other populations? Do they represent similar environments within their countries or the Latin American region, or other low- and middle-income countries? These are three coastal localities, and it would be of interest to know if the findings would be similar in inland environments. Does the particular nature of the rural, transitional or peri-urban environments described here have any other unexplored features? Would studies of migrants moving from one type of location to another add further information? Are some of the indicators assessed in the Ecuador study markers of other environmental factors?

Future studies could do well to investigate the terminologies of 'rural', 'rural-in-transition', 'peri-urban' and 'urban' to develop standardised definitions. When I visited China a few years ago, I found that as a New Zealander my concept of rural

and urban bore little relationship to that of the Chinese—cities, villages and farms are of vastly different scales. Should definitions be based on land use, which is a more conventional approach, or, as the Ecuador study has done, examine infrastructure, socioeconomic factors and lifestyle—and are there other aspects of these three categories that are to be explored further such as other components of diet?²⁰ Are the types and amount of exposures, which appear to be rural or urban in one location, translatable to other places? We need to find the key protective factors in rural environments and the key risk factors in urban environments, and how these vary from one location to another.

Finally, although asthma, rhinitis, eczema and atopy are linked, there is mounting evidence that atopy is much less relevant than previously believed, especially in low- and middle-income countries. Investigators should prioritise research into non-atopic asthma, rhinitis and eczema, and this may shed some light on the process of urbanisation. The lack of progress in finding explanations from genetic studies for the increasing burden of asthma in low- and middle-income countries and the new findings in this journal suggest that research funders should prioritise searches for environmental factors that are changing with 'development'.

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