Annals of Human Biology, March – April 2011; 38(2): 219–227

ISSN 0301-4460 print/ISSN 1464-5033 online
DOI: 10.3109/03014460.2010.515949

informa
healthcare

ORIGINAL ARTICLE

Growth of school children in different urban environments in Argentina

S. L. Dahinten[1,2], L. E. Castro[3], J. R. Zavatti[4], L. M. Forte[5] & E. E. Oyhenart[6,7]

[1]CENPAT-CONICET, Brown 2825, U9120ACF, Puerto Madryn, Argentina, [2]UNPSJB, Brown 3700, U9120ACF, Puerto Madryn, Argentina, [3]Cátedra de Estadística, Facultad de Ciencias Naturales y Museo (FCNyM), Universidad Nacional de La Plata (UNLP), La Plata, Argentina, [4]Aluar, Puerto Madryn, Argentina, [5]IGS-CISAUA.FCNyM.UNLP, La Plata, Argentina, [6]Cátedra de Antropología Biológica IV, FCNyM, UNLP, La Plata, Argentina, and [7]Instituto de Genética Veterinaria 'Ing. Fernando Noel Dulout' (IGEVET), FCV, UNLP – CCT La Plata, CONICET, La Plata, Argentina

Background: **Nutritional transition has been described in various countries, each showing inherent characteristics. Furthermore, different patterns also appear within the same country.**

Aim: **To compare the nutritional status of schoolchildren, of both sexes, living in two Argentine cities with different urban and environment characteristics, from the perspective of nutritional transition.**

Subjects and methods: **The sample comprised 5355 children (6 – 13 years) living in Puerto Madryn (Chubut) and General Alvear (Mendoza), Argentina. Weight and height were transformed into *Z*-scores according to NHANES I- II; underweight, stunting and wasting defined by -2 SD and overweight and obesity calculated according the cut-off proposed by IOTF. Prevalences of nutritional status were estimated.**

Results: **Comparison of the two cities revealed significant χ^2 values for the indicators of nutritional status analysed. Puerto Madryn had higher prevalences of overweight and obesity. General Alvear exhibited higher stunting and underweight values.**

Conclusions: **The cities studied are in different stages of nutritional transition. Puerto Madryn is undergoing growing industrialization and urbanization and thus exhibits characteristics typical of an 'obesogenic' environment. General Alvear, a less complex urban centre, where some cultural patterns related to an agrarian way of life appear to have been retained, is situated at a less advanced stage.**

Keywords: School children, stunting, overweight, Argentina

INTRODUCTION

Human growth reflects the environmental conditions and lifestyle to which individuals are subject. In terms of evolution, the urban–industrial environment is the new adaptation threshold of the species, which, given its significant difference from the ancestral environment, has had an impact on the growth pattern of populations (Schell and Ulijaszek 1999). Migration, which is the predominant factor in the evolution of the species, causing great movements of people within and between continents, is one of the factors that accounts for this phenomenon (Ulijaszek 1994; Cavalli-Sforza and Cavalli-Sforza 1995; Boyd and Silk 2001). Currently, the world is witness to migration from rural to urban environments, mainly rooted in the fast and increasing industrialization process (Brown et al. 1998; Gardner and Halweil 2000a; Bogin 2001).

Urbanization, which is especially fast in developing countries, consolidates populations in a few large industrialized centres, with a resulting increase in impoverished sectors (Schell et al. 1993). According to Popkin and Doak (1998), Gardner and Halweil (2000b), Bogin (2001), Caldwell (2001) and Popkin (2002), this new environment has caused a series of changes in people's diet, health, working and physical activity patterns, amongst others. This can be explained by the nutritional transition model which unfolds in two stages: demographic transition and nutritional transition (Omran 1971; Popkin 2002). Demographic transition results from the industrialization of existing urban centres and the arrival of migrant manpower (Gardner and Halweil 2000a; Caldwell 2001; Popkin 2002). Nutritional transition results in a diet rich in refined carbohydrates and saturated fats which, together with the sedentary habits observed in urban environments, results in an increase in levels of overweight, obesity and chronic disease (Popkin 1998; Uauy et al. 2001).

Nutritional transition has been analysed in different countries, each showing unique features (Adair and Popkin 2005; Popkin 2006). Several studies carried out in Argentina have demonstrated the existence of nutritional transition (Lejarraga et al. 1991; 1993; Abeyá Gilardón and Lejarraga 1995; Dahinten and Zavatti 2003; Orden et al. 2005;

Correspondence: Silvia L. Dahinten, CENPAT-CONICET, Brown 2825, U9120ACF, Puerto Madryn, Argentina. E-mail: dahinten@cenpat.edu.ar
(*Received 26 February 2009; accepted 5 August 2010*)

Oyhenart et al. 2005). Furthermore, different obesity and stunting prevalences have been observed in men and women (Albala et al. 2002; Kobzova et al. 2004; Kelishadi 2007).

The aim of this study is to compare the nutritional status of schoolchildren, of both sexes, living in two Argentine cities with different urban and environmental characteristics, within the nutritional transition context.

METHODS

Study areas

This study was carried out in two Argentine cities: Puerto Madryn and General Alvear, which are located in different geographical areas: Patagonia and Cuyo, respectively (Figure 1).

Puerto Madryn is a coastal city, founded in 1865, in the NE of the Province of Chubut on Golfo Nuevo in Patagonia.

Figure 1. Geographical location of cities studied in the Mendoza and Chubut provinces, Argentina.

The construction and operation of an aluminum reduction plant in the 1970s, the reactivation of the fishing industry in the 1980s and the increase in tourism activities have turned Puerto Madryn into a hub of regional development. As a result, the city has undergone important population growth, from 7000 inhabitants in 1970 to ~58 000 in 2001. The cosmopolitan nature of Puerto Madryn derives from waves of immigrants arriving from Europe (mainly from Spain and Italy), neighbouring Latin-American countries (Bolivia and Chile), various Argentine provinces (especially Buenos Aires and Mendoza) and also from the original settlements of native peoples (mainly the Tehuelche and Mapuche) in Patagonia. According to data obtained from the CNPyV (1991), immigrants represented 53.3% of the total population during the 1980s.

Puerto Madryn, consolidated as one of the most important urban centres in Patagonia, is still undergoing a process of urban and demographic growth based on three dominant economic activities: the metallurgical and metal-mechanics industries, coast and deep-sea fishing and tourism.

The main economic activities are located in the city of Puerto Madryn, which has 79 915 inhabitants, according to data obtained from the DGEyC (2008a). This represents 98.2% of the total population of the department, one of the highest indexes of urban concentration in the country. The remaining population of the department lives in two small villages and the rest are scattered in rural areas.

The Gross Domestic Product (GDP)—calculated as an average of the past 10 years—amounts to 23.7%, 21.9% and 54.4% for primary, secondary and tertiary sectors, respectively (DGEyC 2008b). The GDP in the primary sector is relatively high due to oil extraction, mining and quarrying activities, as well as coast and deep-sea fishing activities, which together amount to 21.7%. If only farming is considered, the percentage drops to 2.2%. The secondary sector accounts for 22% of jobs and its main industries, which are related to aluminum production, fish processing and textile manufacturing activities, contribute 70% of total industrial production (DGEyC 2008b; c). The tertiary sector represents ~75% of total jobs due to the convergence of public and private administrations and the significant growth of tourism activities.

General Alvear is located in the region of Cuyo, in the south of the Province of Mendoza (Figure 1). This town finds its roots in a private agricultural colonization project that was part of a production strategy implemented by the national government at the end of the 19th and the beginning of the 20th century. The 'Alvear Colony' grew due to its main economic activity, i.e. agriculture, and its own internal migration. The progress made by the colony encouraged immigration from all parts of Europe.

Water as a natural resource in the area was particularly relevant in the history of the city, due to its location in an arid region. The Atuel River provided water to the region and was used for irrigation purposes and to develop the main production activities. As a consequence of its intense agrarianism, the city developed industries associated with agriculture, which increased in productivity until the mid 1970s, generating a sort of agrarian specialization in each population centre.

The territory features an oasis-like setting of anthropic genesis. People live in a main urban centre and in urban and rural service areas, forming a network of residential settlements that are quite homogeneous in terms of the level of education, health and communication services within the urban and rural centres and their surrounding areas. This balanced distribution of essential services, amenities and available jobs in agricultural activities accounts for the stability of the territorial structure through demographic changes. The spatial distribution of the population is relatively uniform, with only 50% concentrated in the main city, 20% in close urban and rural centres, while the rest of the people are scattered in rural areas (INDEC 2008).

The GDP of the studied area (an average of the past 10 years) was 21%, 13.5% and 65.5% for primary, secondary and tertiary sectors, respectively. The primary sector is mainly devoted to the production of vegetables, fruit and grapes for wine production. Whilst the primary sector gives rise to 22.4% of total jobs, the secondary sector, which creates employment in industrial activities, represents only 9.5% and specializes in the production of vegetables preserves, fruit preserves and wine (CNA 2002; CNE 2004; DEIE 2008a,b).

In spite of the crisis suffered by the primary economic sector and the implementation of economic policies that discouraged production investment, agriculture and agro-industry activities are still important in the regional economy and in the creation of employment (DEIE 2008b).

Data collection and data analysis

A cross-sectional study in both public and private schools (43% of total schools) was carried out on a sample of 5355 students of both sexes between 6–13 years of age. The children participated in the study following written consent signed by their parents or guardians. A physician assessed school health records and their parent reports. There were no cases of chronic diseases or pathological status. Measurements were made following international protocols (WHO 1995; Cogill 2001) using previously standardized anthropometric techniques (Habitch 1974). Body weight (kilograms) was measured on a digital scale (accuracy, 10 grams) with subjects lightly clothed (weight of clothes was subtracted). Height (centimetres) was measured using a portable vertical anthropometer (accuracy, 1 millimetre).

Data were transformed into *Z*-scores according to the First and Second National Health and Nutrition Examination Survey (NHANES I and II) (Frisancho 1990). Levels of low weight-for-age (underweight), low height-for-age (stunting) and low weight-for-height (wasting) were calculated by *Z*-scores of less than −2 SD (Gorstein et al. 1994). Body-mass index (BMI) was calculated as weight (kg) divided by height (m^2) and classified individuals as having overweight or obesity according to the cut-off proposed by the International Obesity Task Force (IOTF) (Cole et al.

Table I. Sample composition, mean (X), median (MD) and standard deviation (SD).

	Weight (kg)								Height (cm)						BMI					
	Puerto Madryn				General Alvear				Puerto Madryn			General Alvear			Puerto Madryn			General Alvear		
Age (years)	*n*	χ	MD	SD	*n*	χ	MD	SD	χ	MD	SD	χ	MD	SD	χ	MD	SD	χ	MD	SD
Males																				
6.0–6.9	159	23.8	23.2	3.8	215	21.8	21.0	3.3	118.3	118.7	5.2	116.3	117.0	5.3	17.0	16.7	1.9	15.8	15.5	1.8
7.0–7.9	173	26.6	25.8	4.5	228	24.5	23.5	4.5	123.5	123.5	5.2	123.0	123.0	5.1	17.4	17.2	2.0	16.0	15.6	2.1
8.0–8.9	164	30.4	29.2	6.1	212	27.1	26.3	5.0	129.6	129.9	5.9	128.7	128.6	6.2	18.0	17.3	2.8	16.3	15.8	2.0
9.0–9.9	142	33.0	31.2	7.1	209	30.4	29.3	5.9	134.3	133.3	7.2	134.3	133.9	6.6	18.2	17.5	2.9	16.8	16.3	2.4
10.0–10.9	113	37.8	36.4	7.8	203	34.4	32.7	7.5	141.1	140.6	7.1	139.1	139.2	6.1	18.9	17.9	2.8	17.7	17.0	3.2
11.0–11.9	147	41.6	39.4	9.5	202	37.7	36.6	9.3	145.8	145.2	7.2	144.0	143.5	7.6	19.4	18.3	3.4	18.0	17.3	3.2
12.0–12.9	176	46.3	44.2	10.6	182	42.0	40.1	10.0	151.6	151.4	8.2	149.4	149.3	7.6	20.0	19.2	3.2	18.6	18.0	3.4
13.0–13.9	202	54.7	52.6	11.6	62	47.6	46.1	12.0	160.2	159.4	7.8	156.0	156.4	7.7	21.2	20.4	3.6	19.4	18.6	3.6
Total	1276				1513															
Females																				
6.0–6.9	119	23.1	22.8	3.5	167	21.1	20.6	3.4	117.1	116.9	4.8	116.2	115.9	5.5	16.8	16.5	2.0	15.6	15.4	1.8
7.0–7.9	123	25.4	24.6	4.5	198	24.5	23.3	5.0	122.1	122.0	6.3	122.6	122.6	6.6	17.0	16.7	2.2	16.2	15.7	2.0
8.0–8.9	158	28.8	28.0	5.9	194	26.8	25.3	5.9	128.1	127.4	7.1	126.9	126.9	6.5	17.4	17.2	2.4	16.5	16.1	2.5
9.0–9.9	157	33.2	31.2	7.6	207	29.8	27.9	6.3	134.2	134.0	6.6	133.2	133.4	6.3	18.3	17.5	2.9	16.6	16.2	2.4
10.0–10.9	122	37.9	36.2	8.2	193	33.5	32.3	7.4	140.4	140.1	7.0	139.4	139.6	7.3	19.0	18.7	2.9	17.1	16.6	2.6
11.0–11.9	134	41.8	40.5	9.1	211	38.3	37.1	9.3	147.1	147.4	8.2	145.0	144.7	7.6	19.2	18.5	3.2	18.0	17.3	3.1
12.0–12.9	194	47.0	45.7	9.0	159	43.8	42.1	9.7	152.2	152.5	6.7	151.9	152.0	7.0	20.2	19.7	3.2	18.8	18.2	3.2
13.0–13.9	181	50.9	49.8	8.3	49	47.9	47.8	9.2	155.7	155.4	5.6	154.3	154.5	6.9	20.9	20.6	3.1	20.1	19.7	3.4
Total	1188				1378															

2000). The general prevalence of under-nutrition (total number of individuals presenting stunting, wasting or underweight) was also computed, as well as overweight plus obesity (Oyhenart et al. 2005).

Finally, data analysis was performed using a general linear model (GLM), a generalization of ordinary least squares regression, a way of unifying various other statistical models, including linear regression, logistic regression and Poisson regression, in one framework (McCullagh and Nelder 1989). Also χ^2 test were performed, for comparison between populations (Table III).

RESULTS

Table I summarizes the parameters sampled and the means, medians and standard deviations obtained for body weight, height and BMI in General Alvear and Puerto Madryn.

There were significant differences in the prevalence of under-nutrition ($p < 0.01$, $\chi^2 = 29.49$) and overweight plus obesity ($p < 0.01$, $\chi^2 = 145.53$) between the two cities analysed. Under-nutrition was greater in General Alvear (12.5% vs 8.7%) and overweight plus obesity in Puerto Madryn (26.7 vs 17.1%).

The results from the general linear model showed significant differences associated with age for underweight and with sex for stunting and obesity. With the exception of wasting, there were differences between the cities with regard to almost all nutritional status indicators (Table II).

In both cities, the highest prevalences were associated with overweight, followed by stunting. A comparison between the cities revealed significant χ^2 values for all the nutritional status indicators analysed. Nevertheless, whilst Puerto Madryn featured the highest prevalences of overweight and obesity, General Alvear showed higher values in stunting and underweight. Similar results were found for males and females, although no significant differences regarding stunting were found for females in both cities (Table III).

Males and females living in General Alvear showed an increased prevalence of underweight with age. Statistical differences between these two cities were found in males at ages 6–8 and 11–13 and in females at ages 6 and 10–13. Considerable differences regarding stunting were found in males at ages 11 and 13. No significant differences were found in females (Figure 2).

The highest levels of overweight were observed in Puerto Madryn, although significant differences between the two cities were found in males at ages 6 and 7 and in females at ages 6 and 9. Finally, higher levels of obesity were also found in Puerto Madryn, as against those in General Alvear. Males showed higher values at all ages and females at the age of 6 and from 9–12 years of age (Figure 3).

Table II. General linear model for prevalences by age, sex and city differences.

	Age				Sex (Males–Females)				City (General Alvear–Puerto Madryn)			
Nutritional indicators	Estimate	SE	*Z*	*p*	Estimate	SE	*Z*	*p*	Estimate	SE	*Z*	*p*
Underweight	0.11	0.03	3.86	0.00	−0.06	0.12	−0.46	0.64	1.48	0.15	9.62	0.00
Stunting	0.01	0.02	0.22	0.83	−0.31	0.10	−3.05	0.00	0.30	0.10	2.89	0.00
Wasting	0.01	0.08	0.11	0.91	0.31	0.36	0.87	0.39	−18.23	896.05	−0.02	0.98
Overweight	−0.01	0.02	0.58	0.57	0.02	0.08	0.27	0.79	−0.33	0.08	−4.34	0.00
Obesity	−0.01	0.03	−0.52	0.60	0.52	0.12	4.41	0.00	−1.22	0.13	−9.6	0.00

Table III. Prevalences of underweight, stunting, overweight and obesity.

	Puerto Madryn		General Alvear			
	n	Prevalences (%)	*n*	Prevalences (%)	$\chi^{2\star}$	*p*-value
Total sample	2464		2894			
Underweight	55	2.2	249	8.6	100.96	0.000 000 0
Stunting	32	6.9	266	9.2	9.35	0.002 225 6
Overweight	527	21.4	402	10.8	114.23	0.000 000 0
Obesity	141	5.7	91	3.1	21.35	0.000 003 8
Males	1276		1514			
Underweight	24	1.9	130	8.6	59.7	0.000 000 0
Stunting	72	5.6	126	8.3	7.54	0.006 029 8
Overweight	278	21.8	209	10.4	30.62	0.000 000 0
Obesity	82	6.4	52	3.4	13.55	0.000 231 7
Females	1188		1380			
Underweight	31	2.6	119	8.6	41.80	0.000 000 0
Stunting	98	8.3	140	10.1	2.73	0.098 570 0
Overweight	249	21.0	193	11.2	18.36	0.000 018 3
Obesity	59	5.0	39	2.8	7.97	0.00 4763 8

$^{\star}\chi^2$ test for indicators of nutritional status.

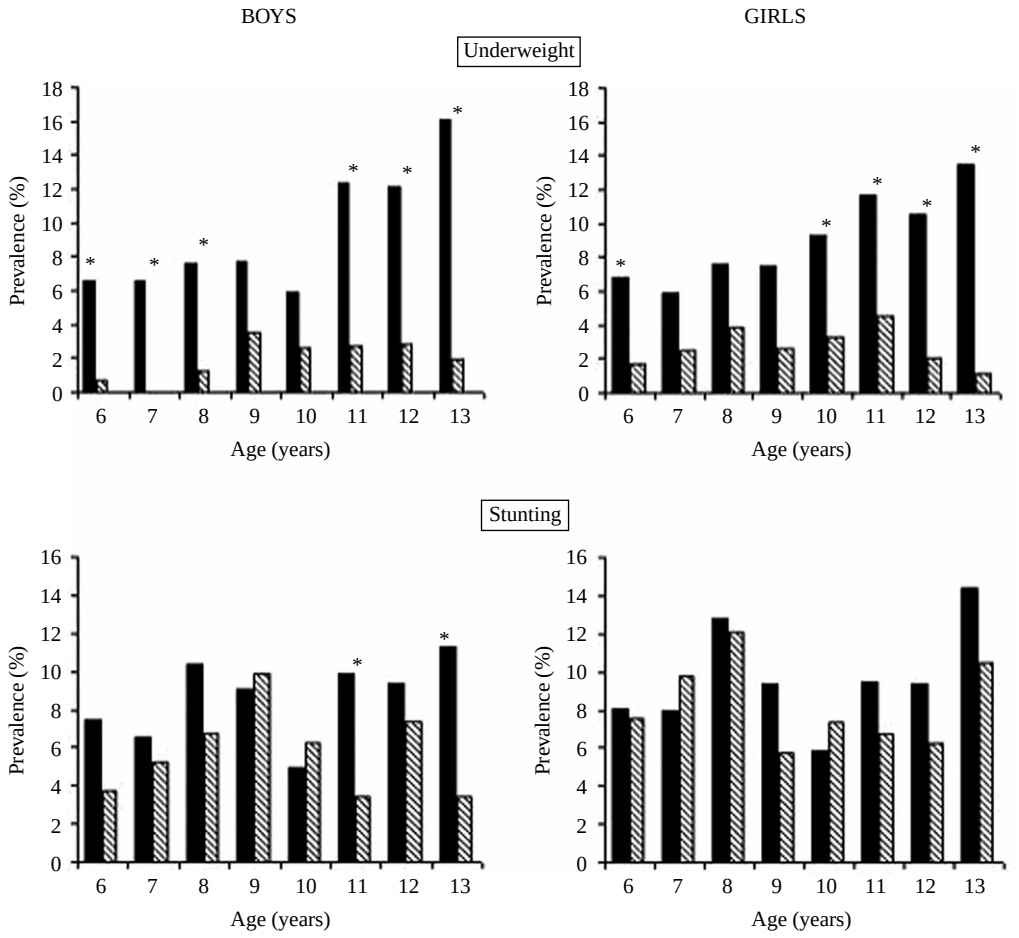

Figure 2. Differences among cities for the prevalences of underweight and stunting according to sex and age. Black bar: General Alvear; Hatch bar: Puerto Madryn.

DISCUSSION

The estimated prevalence of stunting in Latin America and the Caribbean has declined (de Onis et al. 2000). However, stunting continues to be the most significant manifestation of nutritional deficiency in Latin America (Amigo et al. 2000), as observed in this study. Nevertheless, overweight and obesity levels were higher than under-nutrition in both study areas. These results are consistent with the model of variation described for Central and South America (Prentice 2006) and for emerging countries in central Europe where under-nutrition co-exists with obesity (Popkin 1994; 2002; Monteiro and Halpern 2000).

Geographic variation within and between countries has also been observed (Frongillo et al. 1997; Bolzán et al. 2005; Yngve et al. 2007). Oyhenart et al. (2008) reported clinical variation in Argentina: higher levels of under-nutrition in the north, co-existence of under-nutrition and obesity in the centre and higher obesity in the south of the country. Consistently, the highest levels of under-nutrition were observed in General Alvear and of obesity in Puerto Madryn. Similar results were reported by Lejarraga et al. (1991) in Argentine males.

On the other hand, Kelishadi (2007) reported that while obesity levels were higher in females in Brazil, they were higher in males in Argentina and Mexico. In line with this, obesity levels in both cities were higher in males, mainly from 9 years old onwards. In contrast, females featured higher levels of stunting in both cities. As regards Tanner's (1982) hypothesis, the better canalization of females in adverse nutritional circumstances would only be applicable to one of the extremes of malnutrition: obesity.

The cities studied are extremely different in their development and economic structure, indicating that they are at different stages of demographic transition. The magnitude of some of their quantitative demographic and economic parameters also suggests they may be going through different stages of nutritional transition.

In Puerto Madryn, 98% of the total population is concentrated in one main centre, while industrial and rural activities represent 21.9% and 2.2% of the total GDP, respectively. The city was going through a period of growing industrialization and urbanization, with a strong migration input from the centre and north of the country, as well as neighbouring countries. This is likely to create significant changes in the lifestyle of migrants, such as variations in their diet and more sedentary patterns in terms of physical and work activity which, among other consequences, would

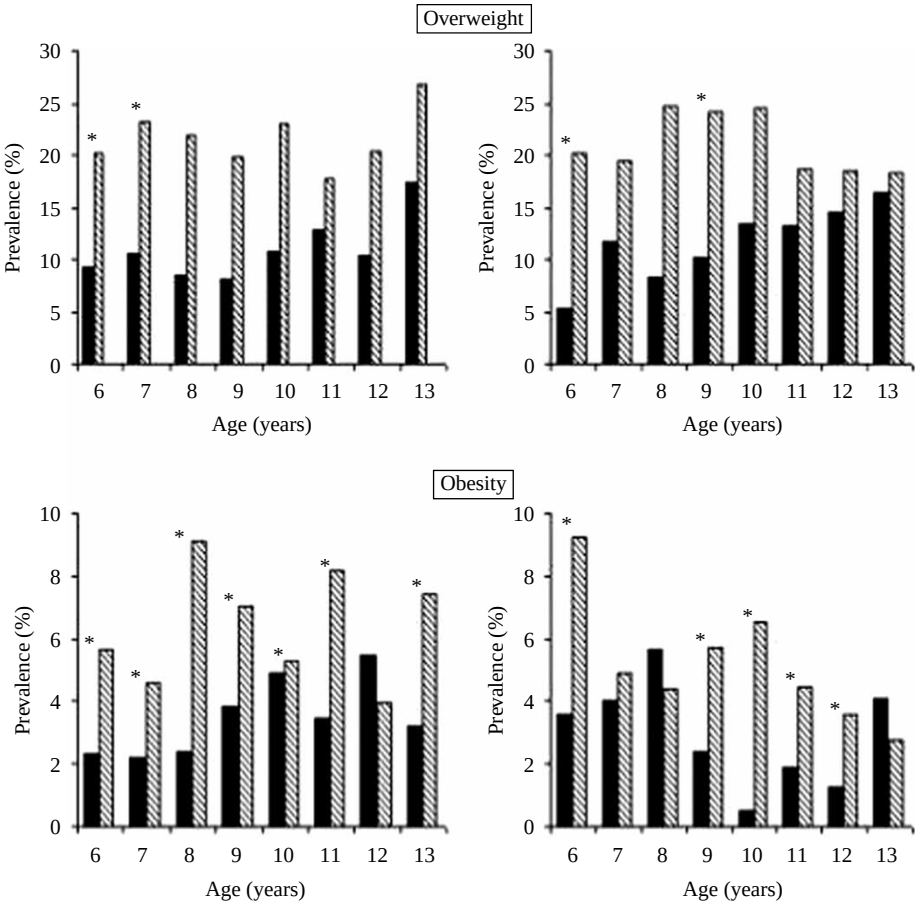

Figure 3. Differences among cities for the prevalences of overweight and obesity according to sex and age. Black bar: General Alvear; Hatch bar: Puerto Madryn.

account for the higher levels of overweight and obesity observed in this city.

The higher overweight and obesity prevalences found in Puerto Madryn seem to be related to the urban way of life, typical of urban-industrial complexes, where rural activities—crops and livestock—are less important. It is noteworthy that Puerto Madryn is not a food producer; this results in a greater consumption of commercially processed foods, of higher density, and a greater proportion of fats and refined carbohydrates. The increasing rates of obesity worldwide are broadly attributed to environments known as obesogenic (French et al. 2001; Brownell 2002; Hill et al. 2003; Ulijaszek and Lofink 2006). The term 'obesogenic environment' was coined by Swinburn et al. (1999), who argued that the physical, economic, social and cultural surroundings within the majority of industrialized nations encourage a positive nutritional energy balance among their inhabitants.

In contrast, General Alvear is a less complex urban centre located in a region where 30% of the total population is scattered in rural areas and the rural GDP is economically important; some cultural patterns related to an agrarian way of life seem to remain unchanged. This difference in lifestyle would explain the lower overweight and obesity levels observed. Therefore, it could be asserted that General Alvear is at a less advanced stage in the nutritional transition, as observed in rural populations (Popkin 1999).

The relationship between nutritional status, socio-environmental conditions and certain lifestyle features suggests that both cities are at different stages in the nutritional transition. Further studies of other urban and rural populations in Argentina are likely to improve knowledge concerning the nutritional transition process.

ACKNOWLEDGEMENTS

The authors are grateful to local authorities and educational staff of General Alvear, (Mendoza) and Puerto Madryn (Chubut) for their valuable assistance and collaboration.
This study was supported by funds from: Agencia Nacional de Promoción Científica y Tecnológica (ANPCyT, PICT 14095 and PICT 01541) and the Universidad Nacional de La Plata (UNLP, 11/N428) and the Universidad Nacional de la Patagonia SJB (UNPSJB, 10/C098).

Declaration of interest: The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

REFERENCES

Abeyá Gilardón E, Lejarraga H. 1995. Prevalencia de obesidad en 88, 861 varones de 18 años. Argentina, 1987. Arch Argent Pediatr 93: 71–79.

Adair LS, Popkin BM. 2005. Are child eating patterns being transformed globally? Obesity 13:1281–1299.

Albala C, Vio F, Kain J, Uauy R. 2002. Nutrition transition in Chile: Determinants and consequences. Public Health Nutr 5:123–128.

Amigo H, Bustos P, Muñoz S. 2000. Risk factors of growth deficit in Chilean school children. J Nutr 131:251–254.

Bogin B. 2001. The growth of humanity. New York: Wiley–Liss.

Bolzán A, Mercer R, Ruiz V, Brawerman J, Marx J, Adrogué J, Carioli N, Cordero C. 2005. Evaluación nutricional antropométrica de la niñez pobre del norte argentino: Proyecto *encuNA*. Arch Argent Pediatr 103:545–555.

Boyd R, Silk JB. 2001. Cómo evolucionaron los humanos? Barcelona: Editorial Ariel.

Brown LR, Gardner G, Halweil B. 1998. Beyond Malthus: Sixteen dimensions of the population problem. Worldwatch Paper 143: 1–45.

Brownell KD. 2002. The environment and obesity. In: Fairburn CG, Brownell KD, editors. Eating disorders and obesity: A comprehensive handbook. 2nd ed. New York: Guilford Press. p 5.

Caldwell JC. 2001. Population health in transition. Bull WHO 79: 159–176.

Cavalli-Sforza LL, Cavalli-Sforza F. 1995. The great human diasporas. Reading, MA: Addison-Wesley Publishing Company.

CNA. 2002. Censo Nacional Agropecuario. Instituto de Estadísticas y Censos (INDEC), Ministerio de Economía de la Nación. Available online at: http://www.indec.gov.ar, accessed November 2008.

CNE. 2004. Censo nacional Económico. Instituto de Estadísticas y Censos (INDEC), Ministerio de Economía de la Nación. Available online at: http://www.indec.gov.ar, accessed November 2008.

CNPyV. 1991. Censo Nacional de Población y Vivienda. Instituto de Estadísticas y Censos (INDEC), Ministerio de Economía de la Nación. Available online at: http://www.indec.gov.ar, accessed November 2008.

Cogill B. 2001. Anthropometric Indicators Measurement Guide. Food and Nutrition Technical Assistance Project. Washington, DC: Academy for Educational Development.

Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. 2000. Establishing a standard definition for child overweight and obesity worldwide International survey. Br Med J 320:1240–1243.

Dahinten SL, Zavatti JR. 2003. Transición nutricional en Patagonia. Rev Arg Antrop Biol 4:64.

de Onis M, Frongillo EA, Blössner M. 2000. Is malnutrition declining? An analysis of changes in levels of child malnutrition since 1980. Bull WHO 78:1222–1233.

DEIE. 2008a. Dirección de Estadísticas e Investigaciones Económicas de la provincia de Mendoza. Producto Bruto Geográfico a precios constantes de 1993, serie 1991–2008. Available online at: http://www.deie.mendoza.gov.ar, accessed December 2008.

DEIE. 2008b. Dirección de Estadísticas e Investigaciones Económicas de la provincia de Mendoza Publicaciones Municipales, Estadísticas Económicas. Available online at: http://www.deie.mendoza.gov.ar, accessed December 2008.

DGEyC. 2008a. Dirección General de Estadísticas y Censos de la provincia del Chubut. Sistema de Información de Comarcas y Comunas (SISCOM), Ficha Municipal Puerto Madryn. Available online at: http://www.estadistica.chubut.gov.ar, accessed December 2008.

DGEyC. 2008b. Dirección General de Estadísticas y Censos de la provincia del Chubut. Cuentas Regionales; Producto Bruto Geográfico a precios constantes de 1993, serie 1993-2007. Available online at: http://www.estadistica.chubut.gov.ar, accessed December 2008.

DGEyC. 2008c. Dirección General de Estadísticas y Censos de la provincia del Chubut. Mercado Laboral; Evolución de la población ocupada según rama de actividad. Available online at: http://www.estadistica.chubut.gov.ar, accessed December 2008.

French SA, Story M, Jeffery RW. 2001. Environmental influences on eating and physical activity. Annu Rev Public Health 22:309–335.

Frisancho AR. 1990. Anthropometric standards for the assessment of growth and nutritional status. Ann Arbor: The University of Michigan Press.

Frongillo EA, de Onis M, Hanson KMP. 1997. Socioeconomic and demographic factors are associated with worldwide patterns of stunting and wasting of children. J Nutr 127:2302–2309.

Gardner G, Halweil B. 2000a. Escaping hunger, escaping excess. Worldwatch Mag 13:25–35.

Gardner G, Halweil B. 2000b. Overfed and underfed. Worldwatch Paper 150:4–68.

Gorstein J, Sullivan K, Yip R, de Onis M, Trowbridge F, Fajans P, Clugston C. 1994. Issues in the assessment of nutricional status using anthropometry. Bull WHO 72:273–283.

Habitch JP. 1974. Estandarización de métodos epidemiológicos cuantitativos sobre el terreno. Boletín de la Oficina Sanitaria Panamericana 76:375–384.

Hill JO, Wyatt HR, Reed GW, Peters JC. 2003. Obesity and the environment: Where do we go from here? Science 299:853–855.

INDEC. 2008. Distribución espacial de la población y urbanización. población urbana, rural y rural dispersa, Serie 1970–2001. Available online at: http://www.indec.gov.ar, accessed January 2009.

Kelishadi R. 2007. Childhood overweight, obesity, and the metabolic syndrome in developing countries. Epidemiol Rev 29:62–76.

Kobzova J, Vignerova J, Blaha P, Krejcovsky L, Riedlova J. 2004. The 6th nationwide anthropological survey of children and adolescents in the Czech Republic in 2001. Eur J Public Health 12:126–130.

Lejarraga H, Abeyá E, Andrade J. 1993. Body mass index in a national representative sample of 88,861 18 year old boys. Argentina, 1987. Pediatric Res 33:663.

Lejarraga H, Abeyá Gilardón E, Andrade JH, Boffi-Boggero HJ. 1991. Evaluación del peso y talla en 88,861 varones de 18 años de la República Argentina. Arch Argent Pediat 89:185–192.

McCullagh P, Nelder JA. 1989. Generalized linear models. 2nd ed. New York: Chapman and Hall.

Monteiro CA, Halpern A. 2000. Epidemiología de la obesidad en Brasil. Nutrición y Obesidad 3:98–105.

Omran AR. 1971. The epidemiologic transition: A theory of the epidemiology of population change. Milbank Mem Fund Quat 29: 509–538.

Orden A, Torres MF, Luis MA, Cesani MF, Quintero FA, Oyhenart EE. 2005. Evaluación del estado nutricional en escolares de bajos recursos socioeconómicos en el contexto de la transición nutricional. Arch Argent Pediatr 103:205–211.

Oyhenart EE, Dahinten SL, Alba JA, Alfaro EL, Bejarano IF, Cabrera GE, Cesani MF, Dipierri JE, Forte LM, Lomaglio DB, Luis MA, Luna ME, Marrodán MD, Moreno Romero S, Orden AB, Quintero FA, Sicre ML, Torres MF, Verón JA, Zavatti JR. 2008. Estado nutricional infanto juvenil en Argentina: variación regional. Rev Arg Antrop Biol 10:1–62.

Oyhenart EE, Orden AB, Forte LM, Torres MF, Luis MA, Quintero FA, Cesani MF. 2005. Transición nutricional en tres ciudades con diferente complejidad urbano-ambiental. Rev Arg Antrop Biol 7: 35–46.

Popkin BM. 1994. The nutrition transition in low income countries: An emerging crisis. Nutr Rev 52:285–298.

Popkin BM. 1998. The nutrition transition and his health implications in lower-income countries. Public Health Nutr 1:5–21.

Popkin BM. 1999. Urbanization, lifestyle changes and the nutrition transition. World Dev 27:1905–1916.

Popkin BM. 2002. The shift in stage of the nutrition transition in the developing world differs from past experiences. Publ Health Nutr 5: 205–214.

Popkin BM. 2006. Global nutrition dynamics: The world is shifting rapidly toward a diet linked with non communicable diseases. Am J Clin Nutr 84:289–298.

Popkin BM, Doak CM. 1998. The obesity epidemic as a worldwide phenomenon. Nutr Rev 56:106–114.

Prentice AM. 2006. The emerging epidemic of obesity in developing countries. Int J Epidemiol 35:93–99.

Schell LM, Smith MT, Bilsborugh A. 1993. Human biological approaches to the study of Third World urbanism. In: Schell LM, Smith M, Bilsborough A, editors. Urban ecology and health in the Third World. Cambridge: Cambridge University Press. p 5.

Schell LM, Ulijaszek SJ. 1999. Urbanism, health and human biology in industrialised countries. Cambridge: Cambridge University Press.

Swinburn B, Egger G, Raza F. 1999. Dissecting obesogenic environments: The development and application of a framework for identifying and priorizing environmental interventions for obesity. Prev Med 29:563–570.

Tanner JM. 1982. Growth as a mirror of the condition of society: Secular trends and class distinctions. In: Malhotra R, editor. Anthropology of development. New Delhi: Mittal Publications. p 13–40.

Uauy R, Albala C, Kain J. 2001. Obesity trends in Latin America: Transiting from under to overweight. J Nutr 131:893–899.

Ulijaszek SJ. 1994. Between–population variation in preadolescent growth. Eur J Clin Nutr 48:5–13.

Ulijaszek SJ, Lofink H. 2006. Obesity in biocultural perspective. Ann Rev Anthropol 35:337–360.

Yngve A, De Bourdeaudhuij I, Wolf A, Grjibovski A, Brug J, Due P, Ehrenblad B, Elmadfa I, Franchini B, Klepp KI, Poortvliet E, Rasmussen M, Thorsdottir I, Perez Rodrigo C. 2007. Differences in prevalence of overweight and stunting in 11-years olds across Europe: The Pro Children Study. Eur J Public Health 18:126–130.

WHO. 1995. Physical status: The use and interpretation of anthropometry. Report of a WHO Expert Committee. World Health Organ Tech Rep Ser 854. Geneva: World Health Organization.