A Comparative Study on Nutritional Status and Body Composition of Urban and Rural Schoolchildren from Brandsen District (Argentina)

Maria Florencia Cesani1, Mariela Garraza1, María Laura Bergel Sanchís2, María Antonia Luis2, María Fernanda Torres1,3, Fabián Aníbal Quintero1,2, Evelia Edith Oyhenart1,2

1 Instituto de Genética Veterinaria. Facultad de Ciencias Veterinarias, Universidad Nacional de La Plata, UNLP-CONICET CCT La Plata, La Plata, Provincia de Buenos Aires, Argentina, 2 Facultad de Ciencias Naturales y Museo (UNLP), La Plata, Provincia de Buenos Aires, Argentina, 3 Facultad de Filosofía y Letras, Universidad de Buenos Aires (UBA), Ciudad Autónoma de Buenos Aires, Argentina

Abstract

The purpose of this study was to analyze whether nutritional status and body composition varies according to the environment of residence (urban or rural) of children in the Brandsen district (Argentina). Weight, height, arm circumference and tricipital and subscapular skinfolds were performed in 1368 schoolchildren aged 3 to 14. NHANES III reference was used to estimate nutritional status -underweight, stunting, wasting, overweight, and obesity- and to evaluate body composition -deficit and excess of adipose (DA, EA) and muscular (DM, EM) tissues of the arm-. Central fat distribution (CFD) was estimated using the subscapular-tricipital index. A structured questionnaire was implemented to evaluate socio-environmental characteristics. Nutritional categories based on body size and body composition were compared between urban and rural areas of residence using Chi-squared tests (χ²). The results indicated for the total sample: 1.1% underweight, 6.9% stunting, 0.4% wasting, 12.1% overweight, 9.7% obesity, 22.0% DM, 2.5% EM, 0.1% DA, 17.6% EA, and 8.5% CFD. Significant differences between urban and rural areas were found only for CFD. The socio-environmental analysis showed that while access to public services and housing quality was significantly better in the urban area, a considerable number of city households lived under deficient conditions, lacked health insurance and had low socioeconomic level. Fifty-three percent of the undernourished children had DM without urban-rural significant differences, and none of them showed DA. In the overweight plus obesity group, 62.8% presented EA, 6.4% EM, 4.7% DM, and 22.8% CFD. The highest percentages of DM and CFD were recorded in rural areas (p = 0.00). We conclude that the child population shows the “double burden” of malnutrition. The environment of residence does not promote any differentiation in the nutritional status. Nevertheless, the increment of central adiposity and, in some cases of muscle deficit in rural children, suggests a consumption of unbalanced diet.

Introduction

A considerable body of literature has documented the rural-urban health disparity in children and adults from developing countries. Most of these studies were focused on discrepancies in child nutritional status, and demonstrated that, on average, urban children are less likely to suffer stunting and underweight [1]–[2]–[3]–[4]–[5]–[6]–[7]. Nevertheless, the urban advantage has been fading in the last decades, since the fast changes in the diet and lifestyle of city dwellers -resulting from industrialization, urbanization and globalization- have triggered marked consequences on the health and nutritional status of the populations [6]. Urban diets include a large consumption of fat-rich food, more sugar, and more processed foods [8] and the accompanying lifestyle is less physically active [9]–[10]. The types of jobs available in urban areas are often more sedentary than those in rural areas, causing changes in physical activity levels. Likewise, changes in leisure-time activities and the different types of transportation available (e.g. buses, cars) result in more sedentary lifestyles [11]–[12]. As a result, an increasing amount of overweight and obese people has been recorded in urban areas throughout the world.

Moreover, there is growing recognition of the emergence of a “double burden” of malnutrition, with under- and over-nutrition occurring simultaneously among different population groups in developing countries [13]–[14]–[15]–[16]. Accordingly, in Argentina undernourishment and overweight have been reported to coexist in many populations [17]–[18]–[19]–[20]–[21]–[22]. This, it was noted that overweight and obese children could simultaneously present excess of fat tissue and deficit of muscle when they live under impoverished residence conditions [23]. Such results illustrate the complexity of this phenomenon and highlight the importance of studying body composition as an essential complement to studies of nutritional assessment [24].

Since 2005, our research team has been working in the Brandsen district (Argentina) analyzing nutritional status in the...
preschool children population [25]–[26]. We have analyzed urban-rural differences and reported the coexistence of undernutrition, overweight and obesity [19]. Even so, while undernutrition was prevalent in suburban areas where the worst social and environmental conditions for optimal growth of children were observed, the highest rates of obesity were recorded in rural areas [19]. Nevertheless, we have not yet analyzed older children or compared body composition between urban and rural areas. Therefore, the aim of this paper was to analyze whether nutritional status and body composition varies according to the environment of residence (urban or rural) of children in the Brandsen district.

Materials and Methods

Ethics statement
This study was approved by the University of La Plata (UNLP), local authorities, and educational and sanitary staff of Brandsen district. Research protocols followed the principles outlined in the Helsinki Declaration and successive modifications as well as those under the National Law N° 25.326 on the protection of personal data.

The study’s goals and procedures were explained during meetings held in each school. Informed consent was signed by the children’s parents. Children whose parents did not sign the forms were not measured. In addition, the children themselves were consulted and only those who agreed (orally) were included in the study.

Population
Brandsen is a district located in the northern area of Buenos Aires Province; its major city is Coronel Brandsen which is situated just a few kilometers away from the cities of La Plata and Buenos Aires (35°10’S, 58°13’W) (Figure 1). According to the last Argentine National Census (2010), the maximum total population was 26,352 inhabitants, with 85% concentrated in urban areas and the other 15% either distributed in smaller towns (fewer than 2,000 inhabitants) or spread in rural areas [28]. Although both

Figure 1. Geographic location of Brandsen District (Buenos Aires, Argentina).
doi:10.1371/journal.pone.0052792.g001
agriculture and agro industry contribute to regional economy, it is the third sector which participates with a greater percentage of Gross Domestic Product (GDP) [28]–[29].

Sample

A cross-sectional anthropometric study was performed in 1368 children (48% boys 52% girls), aged 3 to 14 years, attending urban (Coronel Brandsen town) and rural (Jeppener, Altamirano, Gómez, and Oliden villages) schools of Brandsen district (Table 1). We employed the criteria suggested by the Instituto de Estadísticas y Censos de Argentina (INDEC) to determine whether a population was urban or rural. Their criterion considers as “urban” any population with more than 2000 inhabitants [29].

Data were collected from 20 public educational institutions (kindergarten and elementary school), representing 70% of the total schools of the district. Children with chronic diseases or pathological conditions existing at the moment of the study were excluded.

Anthropometric study

The anthropometric study was carried out following standardized protocols [30].

The following variables were recorded: age: obtained from the identification cards or from the school’s records; body weight (Kg): measured on a digital scale (accuracy, 100 g) with the subjects lightly clothed (the weight of the clothes being subtracted); height (cm): using a portable vertical anthropometer (accuracy, 1 mm); arm circumference (AC): (cm) using an inextensible tape measure (accuracy, 1 mm); tricipital and subscapular skinfolds (TF and SF) (mm): with a Lange caliper using constant pressure (accuracy, 1 mm). Body-mass index (BMI) was calculated as weight (kg) divided by squared height (m²).

To estimate nutritional status, the NHANES III reference was used. The cut-off value was ≤5th percentile to determine low weight-for-age (underweight), low height-for-age (stunting), and low weight-for-height (wasting). Individuals were classified as overweight or obese when their BMI was in the 85th through 95th percentile, respectively [31].

Body composition was estimated on the basis of total (TA), muscle (MA) and fat (FA) areas following Frisancho [31].

\[
TA = \left(\frac{AC^2}{4 + \Pi}\right)
\]

\[
MA = \left[AC - (TF + \Pi)^2\right]/(4 + \Pi)
\]

\[
FA = (TA - MA)
\]

A cut-off point of <5th percentile and >95th was used to determine deficit and excess of adipose (DA, EA) and muscular (DM, EM) tissues of the arm. Finally, fat distribution (central or peripheral) was evaluated using the subscapular-tricipital index (STI) calculated as the ratio between subscapular and tricipital skinfolds (STI = SF/TF) [32]. A STI score higher than 1 was considered as an indicator of high risk of central fat distribution (CFD) [33].

Socio-environmental study

A structured questionnaire, completed by the parents, was implemented to evaluate socio-environmental characteristics, and to measure housing variables by means of information regarding structural and physical amenities [27]. These characteristics provided information about interior and exterior housing conditions.

We asked about: building materials (type of materials used in their construction: low-quality prefab, fired-brick masonry, make-shift materials, and so forth); source of drinking water (piped water system, protected well, rain-tank storage, or unprotected well); wastewater disposal (sewage system or septic tanks (cesspool); fuel for cooking and heating (piped gas, bottled gas (cylinder), kerosene, or firewood); pavement; electricity, waste collection, and critical crowding (more than three persons per room).

Regarding socio-economic status (SES), the following variables were considered: lodging or home-tenure status (house owner, lease holder, or free lodging); parental education (elementary, high school, university); parental job (employed or formal worker, unskilled worker or unqualified worker who performs mostly temporary jobs, informal worker or without work contract, autonomous worker or freelance jobs, and unemployed); health insurance (medical insurance at the expense of the employer or paid by the person -fee for service health insurance plans-); public assistance (referring to national or local programs from government agencies, NGOs, or other entities, that benefit poor families by supplementing their food budget -nutritional support- and/or by providing cash relief to the heads of households -monetary support ;- farming (animal husbandry, orchard, or horticulture).

Statistical analysis

Nutritional categories based on body size and body composition were compared between urban and rural areas of residence using Chi-squared tests (χ²). All statistical procedures were made with SPSS 12.0 statistical program.

Results

Table 2 shows the results of the socio-environmental analysis. Although most of the urban and rural houses were built with fired-brick masonry, the quality of building materials was lower in the rural area. With the exception of electricity, urban households had better access to public services (pavement, piped water system,

| Age (years) | N  | Male | Female | Urban Population | Rural Population |
|-------------|----|------|--------|------------------|------------------|
| 3–3.9       | 170| 85   | 85     | 136              | 34               |
| 4–4.9       | 162| 83   | 79     | 116              | 46               |
| 5–5.9       | 150| 77   | 73     | 98               | 52               |
| 6–6.9       | 118| 60   | 58     | 81               | 37               |
| 7–7.9       | 124| 64   | 60     | 97               | 27               |
| 8–8.9       | 87 | 37   | 50     | 72               | 15               |
| 9–9.9       | 123| 51   | 72     | 83               | 40               |
| 10–10.9     | 125| 51   | 74     | 96               | 29               |
| 11–11.9     | 106| 53   | 53     | 66               | 40               |
| 12–12.9     | 96 | 48   | 48     | 65               | 31               |
| 13–13.9     | 66 | 22   | 44     | 39               | 27               |
| 14–14.9     | 41 | 20   | 21     | 21               | 20               |
| Total       | 1368| 651 | 717 | 970 | 398 |

doi:10.1371/journal.pone.0052792.t001
waste collection and sewage system). In regards to the fuel for cooking and heating, less than 30% of the families of the district had piped gas. Thus, bottled gas (cylinder) was used as main fuel. Additionally, in the rural area a large amount of families used firewood as an alternative source of fuel.

Critical crowding was high in both urban and rural populations, reaching percentages of 49.4 and 45.5 respectively. On the other hand, most of the families owned their homes, but this type of accommodation was more frequent in the urban area, while in the rural areas, 31% of households had free hosting.

Regarding parental education, city-dwellers accredited higher educational levels. Similarly, a greater percentage of parents with formal or free lance jobs were recorded in the urban area. However, the differences between urban and rural areas were only statistically significant for the mothers.

The amount of families with health insurance and monetary support was similar in urban and rural areas. However, city-dwellers received more nutritional support from government agencies, NGOs or other entities, than those in rural areas. Conversely, orchard farming and animal husbandry for consumption were more frequent among rural residents.

The analysis of nutritional status indicated that 1.1% of the total sample (urban plus rural population) suffered underweight, 6.9% stunting, 0.4% wasting, 12.1% overweight, and 9.7% obesity (Table 3). Differences between boys and girls were observed only for stunting ($X^2$: 5.02, $p$: 0.025) and obesity ($X^2$: 50.56; $p$: 0.033) at the age 10.0–10.9. Therefore, data for both sexes were pooled for subsequent statistical analyses.

Prevalence of undernutrition, overweight and obesity was similar in both urban and rural areas (Table 3). The results of the body composition analysis are shown in Table 4. Twenty-two percent of the children had DM, 2.5% EM, 0.1% DA, 17.6% EA, and 8.5% CFD. Significant differences between urban and rural areas were found only for central fat distribution ($X^2$: 22.61; $p$: 0.000) (Table 4).

Table 5 shows the analysis of body composition in undernourished and overweight plus obesity groups. A total 53.0% of the undernourished children had muscular tissue deficit without significant urban-rural differences, and none of them showed deficit of adipose tissue. In the overweight plus obesity group, 62.8% of the children presented EA, 6.4% EM, 4.7% DM, and 22.8% CFD. Significant differences between rural and urban areas were recorded for deficit of muscular tissue and central fat distribution (with highest percentages in rural areas) (Table 5).

### Table 2. Socio-environmental analysis.

| Variables | Urban (%) | Rural (%) | $\chi^2$ | $p$ |
|-----------|-----------|-----------|---------|------|
| **HOUSING VARIABLES** | | | | |
| Building materials | 12.6 | 0.006 |
| Fired-brick masonry | 86.6 | 77.7 |
| Low-quality prefab | 6.6 | 8.6 |
| Makeshift materials | 3.6 | 8.2 |
| Others materials | 3.2 | 5.5 |
| Availability of public services* | | | | |
| Pavement | 33.7 | 26.2 | 4.53 | 0.033 |
| Piped water system | 57.9 | 46.7 | 8.88 | 0.003 |
| Electricity | 92.9 | 92.1 | 0.15 | 0.700 |
| Waste collection | 81.2 | 63.3 | 31.76 | 0.000 |
| Wastewater disposal (sewage system) | 27.8 | 11.4 | 26.01 | 0.000 |
| **Fuel for cooking and heating*** | | | | |
| Piped gas | 21.7 | 28.4 | 4.39 | 0.036 |
| Bottled gas (cylinder) | 75.9 | 69.4 | 3.89 | 0.031 |
| Firewood | 29.7 | 47.0 | 23.89 | 0.000 |
| Critical Crowding* | 49.4 | 45.5 | 0.99 | 0.320 |
| **SOCIOECONOMIC STATUS VARIABLES** | | | | |
| Lodging or home-tenure status | 21.83 | 0.000 |
| House owner | 70.4 | 54.4 |
| Lease holder | 11.6 | 14.6 |
| Free lodging | 18.0 | 31.0 |
| Parental Education | | | | |
| Father | | | | |
| High school and University | 63.9 | 52.8 |
| Elementary school | 6.8 | 2.3 |
| No Data | 29.6 | 45.0 |
| Mother | | | | |
| High school and University | 64.0 | 51.8 |
| Elementary school | 10.9 | 3.8 |
| No Data | 25.1 | 45.0 |
| Parental Job | | | | |
| Father | 0.72 | 0.697 |
| Formal and Free Lance51.3 | 38.7 |
| Unqualified and Informal Job | 14.6 | 12.1 |
| Unemployed | 3.9 | 3.8 |
| No Data | 30.1 | 45.5 |
| Mother | 18.62 | 0.000 |
| Formal and Free Lance30.0 | 16.1 |
| Unqualified and Informal Job | 2.2 | 4.8 |

*The percentage indicate the presence of the variable. doi:10.1371/journal.pone.0052792.t002
Discussion and Conclusions

The nutritional status of a community is an important indicator of its quality of life. This study provides new evidence of the nutritional situation of Argentinean children, and particularly of those living in Brandsen. Like many authors have observed in other Latin American populations, a low percentage of undernutrition (predominantly stunting) and high percentage of overweight and obesity were found [20]–[21]–[34]–[35]–[36]. Furthermore, similar results obtained in a previous work carried out in Brandsen lend support to the observed trend, which is characteristic of countries in nutritional transition [19]–[27]. Over several years, Popkin [37] has extensively analyzed the environmental factors associated to the obesity pandemic, and he has linked the changes in dietary patterns with those in physical activity to explain the nutrition transition that has been observed all over the world and mainly in developing countries.

Some authors have pointed out that cities are much more advanced along this nutritional transition than the countryside, since they have experienced the greatest increase of overweight and obesity [38]–[39]. In urban contexts the range of food choices is greater and prices are generally lower. On the other hand, urban employments often demand less physical exertion than rural ones, and a greater proportion of women work away from home and are too busy to shop for, prepare and cook healthy meals at home [15]. Nevertheless, we did not find urban-rural differences in prevalence of underweight, stunting, wasting, overweight and obesity between urban and rural areas.

No urban-rural differences were found in prevalence of underweight, stunting or wasting. The notion that urban children are less likely to suffer undernutrition than their rural counterparts is based on the idea that urbanization entails better access to food, services and employment opportunities [7]. However, in many cities of developing countries, not everyone is able to benefit equally and it is currently common to find great heterogeneity within a given urban context. According to Dufour and Piperata [43] cities contain more than one type of urban environment and the population that inhabits them is distributed according to SES.

This statement suggests that cities are not uniform in terms of their health status. In agreement with these authors, the analysis of the socio-environmental survey showed that while access to public services like piped water, sewage system, waste collection, etc., and housing quality was significantly better in the urban area, a considerable number of city households lived under sanitary deficient conditions, lacked health insurance and had low socioeconomic level. The internal socio-environmental heterogeneity of Coronel Brandsen city could explain the lack of differences in the nutritional status of urban and rural children.

The assessment of body composition is important to evaluate nutrition and health status. Skinfold measurement is extremely common in epidemiological studies because they are inexpensive and simple to perform and allow the estimation of muscular and fat tissues of the arm was similar in all the children analyzed and central fat distribution between urban and rural areas.

No urban-rural differences were found in prevalence of undernutrition, stunting or wasting. The notion that urban children are less likely to suffer undernutrition than their rural counterparts is based on the idea that urbanization entails better access to food, services and employment opportunities [7]. However, in many cities of developing countries, not everyone is able to benefit equally and it is currently common to find great heterogeneity within a given urban context. According to Dufour and Piperata [43] cities contain more than one type of urban environment and the population that inhabits them is distributed according to SES.
fat distribution was more frequent in rural children. Although fat deposition patterns are known to be basically ruled by genetics [45], they are also associated with particular socio-cultural and environmental conditions [46]–[48]–[49]. The mechanism by which trunk fat deposition influences cardiovascular risk factors is not yet completely understood. However, central fat distribution is an important predictor of increase in plasma triglycerides, HDL cholesterol, systolic blood pressure, and left ventricular mass in children and adolescents [50]–[51]–[52]. Accordingly, these results may indicate that rural children are more prone to health problems.

On the other hand, body composition analysis in undernourished children indicated that about half of them had less muscular mass. Also, 63% of overweight and obese children presented excess of adipose tissue and 5% of them, reduction of muscular mass. This paradoxical coexistence was more evident in rural children, leading us to think that the diet eaten by these children was low in proteins and high in carbohydrates and lipids. Although we did not analyze food habits, Aguirre’s [53]–[54] arguments support our interpretation. This author suggested that during the past decades in Argentina, a single pattern of consumption was replaced by two different types of diets: the “poor people’s food and rich people’s food”. The former is based on carbohydrates, fats and sugars and is cheaper, and the latter, which includes meat, dairy, fruits and vegetables rich in micronutrients, is more expensive [53]–[54]. Therefore, those children who consume diets with excessive amounts of carbohydrate and lipids but deficient in protein, are expected to present overweight or obesity and muscular deficit at the same time. In addition, the significant reduction of physical activity registered in all Argentinean children [55], and especially in those of rural population [42], could explain this paradoxical coexistence of obesity and reduced muscular mass.

The results obtained indicate the necessity of implementing policies and programs to improve socio-environmental conditions and allow better access to good nutrition for these children in order to protect their health and quality of life.

Acknowledgments

The authors are grateful to the local authorities, to the educational and sanitary staff of Brandsen district the Ministry for their valuable assistance and collaboration, and to the guardians and parents for allowing us to make measurements on their children. We also wish to thank Dr. Cecilia Morgan for editing the manuscript.

Author Contributions

Conceived and designed the experiments: MFC EEO. Performed the experiments: MFC MAL MFT FAQ EEO. Analyzed the data: MFC MG MLBS EEO. Contributed reagents/materials/analysis tools: MFC MAL MFT FAQ EEO. Wrote the paper: MFC MG MLBS EAL MFT FAQ EEO.

References

1. Ruel M, Garrett J, Morris S, Maxwell D, Oduaigb O, et al. (1998) Urban challenges to food and nutrition security: A review of food security, health, and care giving in the cities. FCND Discussion Paper 51. Washington: International Food Policy Research Institute.
2. Haddad L, Ruel M, Garrett J (1999) Are urban poverty and undernutrition growing? World Dev 27: 1891–1904.
3. Menon P, Ruel M, Morris S (2000) Socio-economic differentials in child stunting: results from 11 DHS data sets. Food Nut Bull 21: 282–289.
4. Sahn D, Stifel D (2003) Urban-rural inequality in living standards in Africa. J Afr Econ 12: 564–597.
5. Fotso JC (2006) Child health inequities in developing countries: differences across urban and rural areas. Int J Equity Health 5: 9.
6. Fotso JC (2007) Urban-rural differentials in child malnutrition: Trends and socio-economic correlates in sub-Saharan Africa. Health Place 13: 205–225.
7. Van de Poel L (2009) Urbanization, Health and Inequality in the Developing World. Thesis to obtain the degree of Doctor from the Erasmus University Rotterdam.186 p.
8. Popkin BM (2001) The nutrition transition in the developing world. Dev Policy Rev 21: 581–597.
9. Garrett JL, Ruel MT (2005) Stunted child–overweight mother pairs: Prevalence and association with economic development and urbanization. Food and Nut Bull 26: 209–220.
10. King AC, Heussmann R, Brownson RC (2000) Determinants of leisure time physical activity in rural compared with urban older and ethnically diverse women in the United States. J Epidemiol Community Health 54: 667–672.
11. Popkin BM, Gordon-Larsen P (2004) The nutrition transition: worldwide obesity dynamics and their determinants. Int J Obes Relat Metab Disord 28 Suppl 3: 2–9.
12. Katzmarzyk PT, Mason C (2009) The physical activity transition. JPAH 6: 269–280.
13. Popkin BM (2006) Global nutrition dynamics: the world is shifting rapidly toward a diet linked with noncommunicable diseases. Am J Clin Nutr 84: 209–298.
14. Khor GL (2008) Food-based approaches to combat the double burden among women in the United States. J Epidemiol Community Health 54: 667–672.
15. Food and Agriculture Organization (2012) The nutrition transition and obesity. Available: http://www.fao.org/FOCUS/E/obesity/en. Accessed 2012 Aug 31.
16. Varela-Silva MI, Dickinson F, Wilson H, Azcorra H, Griffiths PL, et al. (2012) The Nutritional Dual-Burden in Developing Countries: How is it assessed and what are the health implications? Coll Antropol 36: 39–45.
17. Bejarano I, Dipierri J, Alfaro E, Quispe Y, Cabrera G (2005) Evolución de la prevalencia de sobrepeso, obesidad y desnutrición en escolares de San Salvador de Jujuy. Arch Argent Pediatr 103: 101–109.
18. Bolzan A, Mercer R, Ruiz V, Brammerman J, Mars J, et al. (2005) Evaluación nutricional antropométrica de la niñez pobre del norte argentino. Proyecto enCUaNa. Arch Argent Pediatr 103: 545–555.
19. Cesani MF, Zonta L, Castro L, Torres MF, Forte LM, et al. (2007) Estado nutricional y parasitosis intestinales en niños residentes en zonas urbanas, periurbana y rural del partido de Brandsen (Buenos Aires, Argentina). Rev Arg Antropol Biol 9: 105–121.
20. Ministerio de Salud de la Nación. Encuesta Nacional de Nutrición y Salud (2007) Available: http://www.msal.gov.ar/htm/Site/enmns/site. Accessed 2012 Aug 31.
21. Oyhenart EE, Dahintel SN, Alba JA, Alfaro EL, Bejarano IF, et al. (2008) Estado nutricional infantil en distintas zonas de Argentina: variación regional. Rev Arg Antropol Biol 10: 1–62.
22. Zonta LA, Oyhenart EE, Navone GT (2011) Nutritional vulnerability in Misiones Guaraní adolescents and adults from Misiones, Argentina. Am J Hum Biol 23: 592–600.
23. Oyhenart EE, Torres MF, Quintero FA, Luis MA, Cesani MF, et al. (2007) Estado nutricional y composición corporal de niños pobres residentes en barrios periféricos de La Plata (Argentina). Rev Panam Salud Pública 22: 194–201.
24. Marrodán Serrano MD, Santos Benet MG, Mesa Santurindio MS, Cabañas Armesilla MD, González-Montero de Espinosa M, et al. (2007) Técnicas analíticas en el estudio de la composición corporal. Antropometría frente a sistemas de biomediadoz y tetroz. Nutr Clin Diet Hosp 19: 11–19.
25. Oyhenart EE, Orden AB, Forte LM, Torres MF, Luis MA, et al. (2005) Transición nutricional en tres ciudades de diferente complejidad urbano ambiental. Rev Arg Antropol Biol 7: 35–46.
26. Luis MA, López Armengol MF, Orden AB, Torres MF, Cesani MF, et al. (2006) Estado nutricional y parasitosis en la población escolar de Brandsen: una experiencia de articulación entre Universidad y Comunidad. Revista de la Escuela Superior de Trabajo Social. UNLP. Escenarios 11: 35–44.
27. Cesani MF, Castro LE, Luis MA, Torres MF, Quintero FA, et al. (2010) Sobrepeso y obesidad en escolares de Brandsen en relación a las condiciones socio-ambientales de residencia. Arch Argent Pediatr 108: 294–302.
28. Instituto Nacional de Estadistica y Censos (INDEC) (2010) Censo Nacional de Población, Hogares y Vivienda. Available: http://www.censo2010.indec.gov.ar. Accessed 2012 Aug 31.
29. Instituto Nacional de Estadistica y Censos (INDEC) (2004) Censo Nacional de Población, Hogares y Vivienda. Available: http://www.indec.gov.ar. Accessed 2012 Aug 31.
30. Lohman TG, Roche AF, Martorell R (1988) Anthropometric Standards: An Interactive Nutritional Reference of Body Size and Body Composition for Children and Adults. Ann Arbor, MI: University of Michigan Press. 335 p.
31. Fraisanco R (2008) Anthropometric Standards: An Interactive Nutritional Reference of Body Size and Body Composition for Children and Adults. Ann Arbor, MI: University of Michigan Press. 335 p.
32. Deurenberg P, Pieters J, Hautvast J (1990) The assessment of the body fat percentage by skinfold thickness measurements in childhood and young adolescence. Br J Nutr 63: 293–303.
33. Martínez E, Devesa M, Barcácas J, Amador M (1993) Indice subescapular/tricipital: valores porcentiles en niños y adolescentes cubanos. ALAN 43: 199–203.
34. de Onis M, Blossner M (2000) Prevalence and trends of overweight among preschool children in developing countries. Am J Clin Nutr 72: 1032–1039.
35. Barra PMR, Amaya CH (2006) Transición nutricional: una revisión del perfil latinoamericano. ALAN 56: 3–11.
36. Lamounier JA (2009) Transición epidemiológica nutricional en crianç±s adolescentes argentinos de áreas carentes. Rev Paul Pediatr 27:124–126.
37. Pueyrredón P, et al. (2004) Obesidad en Argentina: ¿Hacia un nuevo fenotipo? Reporte del Centro de Estudios sobre Nutrición Infantil (CESNI). Buenos Aires: CESNI. 58 p.
38. Stephen R, Danich MD, Morrison JA, Sprecher DL, Khoury P, et al. (1999) Association of Body Fat Distribution and Cardiovascular Risk Factors in Children and Adolescents. Circulation 99: 541–545.
39. Kopelman P (2007) Health risks associated with overweight and obesity. Obes Rev 8: 13–17.
40. Zimmet P, Alberti G, Kaufman F, Tajima N, Silink M, et al. (2007) The metabolic syndrome in children and adolescents. Pediatr Diabetes 8: 299–306.
41. Aguirre P (2005) Estrategias de consumo: qué comen los argentinos que comen? Buenos Aires: Colección Políticas públicas. CIEPP. 288 p.
42. Aguirre P (2011) Consecuencias del ajuste en la alimentación. Voces en Fenix 7: 52–59. Available: www.vocesenfenix.com.ar. Accessed 2012 Aug 30.
43. Comité Nacional de Medicina del Deporte Infanto-Juvenil, Subcomisión de Epidemiología (2003) Consenso sobre factores de riesgo de enfermedad cardiovascular en pediatría. Sedentarismo. Arch Argent Pediatr 103:450–463.