

Nutritional status of 8-year-old rural and urban Italian children: a study in Pistoia, Tuscany

Monica Tognarelli,¹ Paola Picciolli,¹ Stefania Vezzosi,¹ Alda Isola,¹ Franca Moretti,¹ Elena Tommasetto,¹ Anna Laura Fantuzzi² and Giorgio Bedogni³

¹Servizio di Igiene degli Alimenti e della Nutrizione, Azienda Sanitaria Locale 3, Pistoia, Italy, ²Modulo di Scienza dell' Alimentazione e Dietetica, Azienda Sanitaria Locale, Modena, Italy and ³Cattedra di Nutrizione Umana, Università di Modena e Reggio Emilia, Modena and Centro Studi Fegato, Basovizza, Trieste, Italy

In this study, performed in the province of Pistoia (Italy), we tested whether 8-year-old children living in rural areas differed from their urban peers as far as nutritional status, dietary habits and physical activity are concerned. The study sample was randomly selected to include 50% of the children attending the third elementary class in the province of Pistoia during 2002. A total of 1006 children underwent an anthropometric evaluation and an assessment of dietary habits and physical activity by means of specific questionnaires. Of these children, 927 were born in Italy and are described in this report. The relationship between body mass index (BMI <5th percentile versus 5th ≤ BMI <85th percentile versus 85th ≤ BMI <95th percentile versus BMI ≥95th percentile) and the environment (urban versus rural) was of borderline significance ($P = 0.051$). However, the percentage of children with BMI ≥85th percentile was greater in rural (24%) than in urban (18%) areas ($P = 0.012$). The choice of foods and the physical activity of rural children mirrored those of urban children. These data sound as an alarm in view of the current epidemics of obesity that are invading Italy and other Mediterranean countries.

Introduction

In recent years, a trend toward increased consumption of energy-dense foods and reduced physical activity has been described in many rural areas worldwide (Popkin, 2001; Liebman *et al.*, 2003). This is the most probable reason why obesity and its complications are being increasingly reported in rural communities, in both developed

and developing countries (Popkin, 2001; Liebman *et al.*, 2003). Within this background, Mediterranean Basin countries such as Italy are increasingly losing their 'Mediterranean advantage' (Laurenzi *et al.*, 1989). For instance, adherence to a Mediterranean diet is associated with reduced total mortality (Trichopoulou *et al.*, 2003) and

Correspondence to: Dr Giorgio Bedogni, Human Nutrition Chair, Department of Hygiene, Microbiology and Biostatistics, Faculty of Medicine and Surgery, University of Modena and Reggio Emilia, Via Campi 287, 41100 Modena, Italy.
E-mail: giorgiobedogni@libero.it

with a lower prevalence of cardiovascular risk factors (Panagiotakos *et al.*, 2004). Tuscany is internationally renowned for its rural traditions but, similarly to other Italian regions (Barbagallo *et al.*, 2001, 2002), may be undergoing a nutritional transition (Masala *et al.*, 2003) and is at risk of losing its Mediterranean advantage. Contrarily to developing countries (Martorell *et al.*, 2000), the nutritional status of urban versus rural children has not been systematically investigated in developed countries. In the present study, we tested whether children living in rural and urban areas of Pistoia, Tuscany differed from their urban peers as far as nutritional status, dietary habits, and physical activity are concerned.

Materials and methods

Study population

The province of Pistoia is located in the upper-central part of Tuscany and comprises 22 town councils, of which only six have a population of 10,000. For the purpose of this study, urban and rural areas were defined according to the Agricultural Authority of Tuscany (i.e. on the basis of dimensions, population density, local economy, and historical traditions). In September 2001, we selected 50% of the children expected to attend the third elementary class in the public schools of the province of Pistoia in 2002. The selection was done using a randomisation procedure based on the number of schools, the number of third elementary classes in each school, and the number of children in each class. All third elementary classes of a given school and all children of each class were selected. Urban and rural children represented 55% and 45% of the planned study population, respectively. The children were measured and interviewed during a school day with the help of their teachers and with the informed consent of their parents. The study protocol was approved by the local School Authority and by the local Ethical Committee.

Anthropometry

Anthropometric measurements were performed following the *Anthropometric Stan-*

ardization Reference Manual (Lohman *et al.*, 1988). Weight was measured to the nearest 0.1 kg using an electronic scale, and height to the nearest 0.01 m using a Harpenden portable stadiometer. Skinfolts (triceps and subscapular) were measured to the nearest 0.001 m using a Holtain caliper, and circumferences (arm and waist) to the nearest 0.001 m using an anthropometric tape. Weight and height were always measured by two operators (S.V. and E.T.) and the same occurred for skinfolts and circumferences (F.M. and A.I.). All operators were standardised before and during the study by two experienced anthropometrists (A.F. and G.B.) according to standard procedures (Johnston & Martorell, 1988). The body mass index (BMI) was calculated as weight (kg)/height (m)². The sum of triceps and subscapular skinfolts was employed as an index of adiposity, and the arm muscle area, calculated from arm circumference and triceps skinfold without bone correction, was used as an index of muscularity (Frisancho, 1990). Using the classification of the International Obesity Task Force, children with BMI ≥ 85 th and < 95 th percentiles for age were classified as 'at risk of overweight' and those with BMI ≥ 95 th percentile for age as 'overweight' (Bellizzi & Dietz, 1999; Dietz & Bellizzi, 1999). Moreover, children with BMI < 5 th percentile for age were classified as 'underweight', and those with BMI ≥ 5 th and < 85 th percentiles for age as 'normal weight'. Z-scores of weight for age (Z-weight), height for age (Z-height) and BMI for age (Z-BMI) were calculated from National reference data (Cacciari *et al.*, 2002) using the LMS method. A Z-score is the difference between the individual value and the mean population value divided by the standard deviation of the population, and it can be easily converted into a percentile (Frisancho, 1990).

Dietary habits questionnaire

Because the assessment of food intake by recall and food-frequency methods is often inaccurate in children younger than 10 years (Livingstone & Robson, 2000), we decided to classify the dietary habits of our children on the basis of food never eaten or

eaten every day in a week. Besides the difficulty of obtaining more accurate information, this classification was chosen because it had the potential for being employed in an educational campaign focusing on the daily consumption of specific foods. To this aim, the consumption of a given food was coded as: (1) 'every day of the week', (2) 'not every day of the week', and (3) 'never'. The questionnaire comprised six subsections (breakfast, morning snack, lunch, afternoon snack, dinner, and evening snack) that investigated the consumption of specific foods. Besides common Italian foods, the list included traditional local foods. Because the study was performed between January and June 2002, the effect of seasonality on dietary habits was controlled for by administering the questionnaire to a similar number of rural and urban children during the same month.

Physical activity questionnaire

The questionnaire on physical activity comprised questions on activities performed during free time (riding bike, playing with the ball, watching television, playing video-games) and systematic physical activity (sport type and frequency). As for food consumption, the frequency of a given activity was coded as: (1) 'every day of the week', (2) 'not every day of the week', and (3) 'never'. The question about sport had to be answered directly by the children. The question about sport frequency was coded as: (1) 'one time per week', (2) 'from two to three times per week', and (3) 'more than three times per week'. Because the questionnaire was administered together with that on dietary habits, possible effects of seasonality on physical activity were taken into account.

Repeatability of the dietary and physical activity questionnaires

The repeatability of the dietary and physical activity questionnaires was assessed by comparing the answers given by a randomly chosen subsample of 15 children on one occasion and 30 days after. An agreement between the first answer and the second answer was considered to exist when they

were the same (0='never', 1='not every day of the week', 2='every day of the week', 3=not answered) (McDowell & Newell, 1996). The agreement was more than acceptable, being comprised of between 83% and 100% for dietary habits, and between 92% and 100% for physical activity.

Statistical analysis

All variables except skinfolds were normally distributed. Values are given as means and standard deviations unless specified otherwise. Between-group comparisons of continuous variables were performed by unpaired *t*-tests and those of categorical variables by Fisher's Exact Test. Between-group differences in the relationship between BMI status (underweight versus normal-weight versus at risk of overweight versus overweight) and the environment (rural versus urban) were evaluated using the Pearson's chi-square test. Statistical significance was set to $P < 0.05$ for all tests. Statistical analysis was performed on a Mac OS computer using the Statview 5.0.1 software package (SAS Institute, Cary, NC, USA).

Results

Study population

In 2001, 53 out of 88 schools were randomised to yield a number of 72 classes and 1275 children. Letters were sent to the parents of the children asking for their informed consent. The consent was obtained for 1063 children, representing 84% of the study sample. Fifty-six children (5%) were not in the class or could not be measured (e.g. because of a plaster cast) when the study was performed, so data are available for 1006 children. Seventy-nine children were born outside Italy and are not included in the present analysis.

Anthropometry

The anthropometric characteristics of the 927 children born in Italy are presented in Table 1. The male:female ratio was the same in urban and rural children ($P = 0.999$). Age was similar in both groups ($P = 0.070$), and the same was true for weight ($P = 0.079$),

Table 1. Anthropometric measurements of 8-year-old rural and urban children living in Pistoia, Tuscany

Measurement	Rural (n = 482)	Urban (n = 445)	P value (rural versus urban)
Sex (male/female)	249/233	229/216	0.999
Age (years)	8.7 ± 0.3	8.6 ± 0.4	0.070
Weight (kg)	32.5 ± 7.3	31.7 ± 7.1	0.079
Z-weight	0.18 ± 1.04	0.10 ± 1.05	0.230
Height (m)	1.33 ± 0.06	1.33 ± 0.06	0.554
Z-height	0.09 ± 1.02	0.12 ± 1.03	0.632
BMI (kg/m ²)	18.3 ± 3.1	17.9 ± 3.0	0.047
Z-BMI	0.16 ± 1.05	0.03 ± 1.05	0.072
Arm circumference (cm)	20.9 ± 3.1	20.7 ± 3.0	0.361
Waist circumference (cm)	60.5 ± 7.2	59.4 ± 6.7	0.015
Sum of two skinfolds (mm)*†	17.1†	17.3	0.929
Arm muscle area (cm ²)*	21.3 ± 4.0	21.3 ± 4.2	0.892

* Available for 727 children.

† Geometric mean.

Z-weight ($P = 0.230$), height ($P = 0.554$) and Z-height ($P = 0.632$). The BMI was significantly higher in rural children ($P = 0.047$) but there was no difference in Z-BMI ($P = 0.072$). Arm circumference was similar in both groups ($P = 0.361$) but waist circumference was significantly higher in rural children ($P = 0.015$). The sum of two skinfolds is given only for 727 children because the inter-operator variability in triceps and/or subscapular skinfold thickness measurement was too high in 200 children according to current standards (Johnston & Martorell, 1988; Lohman *et al.*, 1988). In most cases, skinfolds could not be measured reproducibly because of a very lean or fatty arm and/or a fatty trunk. These 727 children did not differ, however, in sex, age, weight, height and BMI from the total study population (data not shown). In this subsample of children, there was no difference in the sum of two skinfolds ($P = 0.929$) and arm muscle

area ($P = 0.892$) between rural and urban areas.

The BMI status of urban and rural children is presented in Table 2. The between-group difference in the relationship between BMI status (underweight versus normal-weight versus at risk of overweight versus overweight) and the environment (urban versus rural) was of borderline significance ($P = 0.051$). The percentage of children with BMI ≥ 85 th percentile was, however, greater in rural (24%) than in urban areas (18%) ($P = 0.012$, Fisher's Exact Test).

Dietary habits

The rate of unanswered questions on dietary habits was 5%. Only the most relevant data that emerged from the study of dietary habits will be discussed here. As far as breakfast is concerned, only 67% of the children did eat it regularly (i.e. 'every day') ($P = 0.999$ for urban versus rural children), with 30% eating it irregularly (i.e. 'not every day') and 3% not eating it at all (i.e. 'never'). Milk was eaten regularly at breakfast only by 42% of the children ($P = 0.503$ for urban versus rural children). Morning and afternoon snacks were eaten regularly or irregularly by 99% of the children and were represented mostly by a local food named 'schiacciata' (kind of white pizza with oil). It must be noted, however, that this food is typically consumed with salted pork meats and that this was done regularly or irregularly by 62% of the

Table 2. Body mass index status of 8-year-old rural and urban children living in Pistoia, Tuscany

Status	Rural	Urban*
Underweight (%)	4	5
Normal weight (%)	72	77
At risk of overweight (%)	16	11
Overweight (%)	8	7

* $P = 0.051$ for the relationship between body mass index and the environment.

children. An evening snack, consisting mainly of milk and biscuits, was consumed by about 15% of the children. Lunch and dinner were regularly eaten by almost all children. As food groups are concerned, the most interesting findings emerged when the foods were classified as 'never eaten'. This analysis was very conservative because a food was classified as eaten even if it was consumed in just one of six occasions (breakfast, lunch, dinner and three snacks). Among the foods never eaten, yoghurt was the most frequent (36%), followed by pulses (21%), fish (15%), eggs (15%), vegetables (14%), milk (9%), fruits (8%), pasta or rice (3%), potatoes (3%), meat (1%) and bread (1%). Wine was consumed by 24% of the children. Interestingly, there was no difference in the consumption of any food ('every day of the week' + 'not every day of the week' versus 'never') between urban and rural children ($P > 0.05$ for all tests).

Physical activity

The rate of unanswered questions on physical activity was 3%. As leisure physical activity is concerned, a greater number of rural than urban children rode bikes during free time (86% versus 75%, $P < 0.0001$). However, a similar number of rural and urban children played with the ball (81% versus 84%, $P = 0.292$) during free time. Television watching and videogame playing were equally frequent among urban and rural children (95% versus 97%, $P = 0.227$ and 73% versus 68%, $P = 0.081$). As far as systematic physical activity is concerned, 69% of the children declared to practise a sport. The most practised sports were swimming (28%), soccer (22%), dancing (11%), basketball (9%), volleyball (6%), gymnastics (6%) and tennis (5%). However, only 60% of children did sport at least twice per week (i.e. in a truly systematic way). Moreover, no difference in sport frequency was found between urban and rural children ('two to three times per week' + 'more than three times per week' versus 'one time per week', $P = 0.382$).

Discussion

In this study we tested whether 8-year-old children living in rural areas of Tuscany differed from their urban peers as far as nutritional status, dietary habits and physical activity are concerned.

As far as nutritional status is concerned, the BMI of rural children was greater than that of urban children ($P = 0.047$) but Z-BMI was similar ($P = 0.072$). There was, however, a borderline association between BMI status and the environment ($P = 0.051$) and a greater percentage of children with BMI ≥ 85 th percentile in rural than in urban areas (24% versus 18%, $P = 0.012$). Because the prevalence of overweight was similar in rural and urban areas (8% versus 7%), this difference was clearly due to the greater number of children at risk of overweight in rural than in urban areas (16% versus 11%). As far as dietary habits are concerned, the most surprising finding of this study was that, within the limitations of the employed questionnaire, the food choices of rural children mirrored closely those of urban children. Pulses, a landmark food for Tuscany throughout the centuries, were not consumed by 21% of urban and rural children. Other foods usually consumed in rural areas, such as eggs and vegetables, were equally not consumed by 15% of urban and rural children. Wine was consumed by 24% of the children, even if wine consumption at this age is discouraged by Italian Nutritional Guidelines. As far as physical activity is concerned, besides a greater frequency of bike riding among rural children, other free time activities such as playing with ball, watching television and playing with videogames, were equally frequent in rural and urban children.

The limitations of this study should be kept in mind. Even if it was performed on a representative sample of children, its results may not necessarily extend to other rural areas of Tuscany, where the Mediterranean tradition may be stronger or weaker. We did not attempt to quantify food intake, because traditional methods of assessing food intake are often unsatisfactory in children of this

age (Livingstone & Robson, 2000). The employed questionnaire focused on nutritional habits also because they are more suitable to promotion. Instead of studying children of greater age, whose food habits could be evaluated in greater detail, we focused on 8-year-old children for two reasons: (1) to have the possibility of performing a 2-year follow-up study in the same schools, with simplified logistics, and (2) to test the feasibility of a nutritional education campaign on young children. This latter point explains why we decided not to involve the mothers in the identification of food eaten by their children.

Using the results of this study, in June 2002 we started an educational campaign, now running for 22 months, involving the press, mass media, schools, health authorities, and public authorities of the province of Pistoia. A book and a society game were also created, distributed in schools, and used by teachers during school hours to teach some very basic nutritional principles to the chil-

dren. The key messages of this ongoing campaign are: (1) eat your breakfast every day, (2) eat legumes and vegetables, (3) eat fish and eggs, (4) do not drink wine until you are older, and (5) spend less time in front of the television.

In conclusion, children living in rural areas of Pistoia, Tuscany are similar to their urban peers as far as anthropometry, nutritional habits, and physical activity are concerned. There is, however, a greater prevalence of risk of overweight and of overweight in rural areas. This sounds as an alarm in view of the current epidemics of obesity that are invading Italy and other Mediterranean countries.

Acknowledgements—This study was performed as a part of the institutional activity of the Azienda Sanitaria Locale 3, Pistoia, coherently with the indications given by the Tuscany Region Health Plan 2002–2004. The authors thank A. Maraviglia, G. Marchi, M. Mariani, G. Nardone, F. Profeti and E. Ricciardi for their technical assistance during the study. Our thanks go also to the teachers and the parents of the children, whose support was essential for the completion of this project.

References

- Barbagallo CM, Cavera G, Sapienza M, Noto D, Cefalu AB, Pagano M, Montalto G, Notarbartolo A & Averna MR (2001): Prevalence of overweight and obesity in a rural southern Italy population and relationships with total and cardiovascular mortality: the Ventimiglia di Sicilia project. *Int. J. Obes. Relat. Metab. Disord.* **25**, 185–190.
- Barbagallo CM, Cavera G, Sapienza M, Noto D, Cefalu AB, Polizzi F, Onorato F, Rini G, Di Fede G, Pagano M, Montalto G, Rizzo M, Descovich G, Notarbartolo A & Averna MR (2002): Nutritional characteristics of a rural Southern Italy population: the Ventimiglia di Sicilia Project. *J. Am. Coll. Nutr.* **21**, 523–529.
- Bellizzi MC & Dietz WH (1999): Workshop on childhood obesity: summary of the discussion. *Am. J. Clin. Nutr.* **70**, 173S–175S.
- Cacciari E, Milani S, Balsamo A, Dammacco F, De Luca F, Chiarelli F, Pasquino AM & Vanelli M (2002): Italian cross-sectional growth charts for height, weight and BMI (6–20 y). *Eur. J. Clin. Nutr.* **56**, 171–180.
- Dietz WH & Bellizzi MC (1999): Introduction: the use of body mass index to assess obesity in children. *Am. J. Clin. Nutr.* **70**, 123S–125S.
- Frisancho AR (1990): *Anthropometric Standards for the Assessment of Growth and Nutritional Status*. Champaign, IL: Human Kinetics Books.
- Johnston FE & Martorell R (1988): Population surveys. In *Anthropometric Standardization Reference Manual*, eds TG Lohman, AF Roche & R Martorell, pp. 107–110. Champaign, IL: Human Kinetics Books.
- Laurenzi M, Stamler R, Trevisan M, Dyer A & Stamler J (1989): Is Italy losing the 'Mediterranean advantage?' Report on the Gubbio population study: cardiovascular risk factors at baseline. Gubbio Collaborative Study Group. *Prev. Med.* **18**, 35–44.
- Liebman M, Pelican S, Moore SA, Holmes B, Wardlaw MK, Melcher LM, Liddil AC, Paul LC, Dunnagan T & Haynes GW (2003): Dietary intake, eating behavior, and physical activity-related determinants of high body mass index in rural communities in Wyoming, Montana, and Idaho. *Int. J. Obes. Relat. Metab. Disord.* **27**, 684–692.
- Livingstone MB & Robson PJ (2000): Measurement of dietary intake in children. *Proc. Nutr. Soc.* **59**, 279–293.
- Lohman TG, Roche AF & Martorell R, eds (1988), *Anthropometric Standardization Reference Manual*. Champaign, IL, Human Kinetics Books.
- Martorell R, Kettel Khan L, Hughes ML & Grummer-Strawn LM (2000): Overweight and obesity in preschool children from developing countries. *Int. J. Obes. Relat. Metab. Disord.* **24**, 959–967.

- Masala G, Assedi M, Saieva C, Salvini S, Cordopatri G, Ermini I, Martinez Mdel C, Tanzini D, Zacchi S, Ceroti M & Palli D (2003): The Florence city sample: dietary and life-style habits of a representative sample of adult residents. a comparison with the EPIC-Florence volunteers. *Tumori* **89**, 636–645.
- McDowell I & Newell C (1996): The theoretical and technical foundations of health measurement. In *Measuring Health*, eds I McDowell & C Newell, pp. 10–46. New York: Oxford University Press.
- Panagiotakos DB, Pitsavos C, Chrysohou C, Skoumas J, Tousoulis D, Toutouza M, Toutouzas P & Stefanadis C (2004): Impact of lifestyle habits on the prevalence of the metabolic syndrome among Greek adults from the ATTICA study. *Am. Heart J.* **147**, 106–112.
- Popkin BM (2001): Nutrition in transition: the changing global nutrition challenge. *Asia Pac. J. Clin. Nutr.* **10** (Suppl.), S13–S18.
- Trichopoulou A, Costacou T, Bamia C & Trichopoulos D (2003): Adherence to a Mediterranean diet and survival in a Greek population. *N. Engl. J. Med.* **348**, 2599–2608.