European Journal of Clinical Nutrition (2005) 59, 82–87
 0954-3007/05 $30.00
www.nature.com/ejcn

ORIGINAL COMMUNICATION

Female gender and wealth are associated to overweight among adolescents in La Paz, Bolivia

A Pérez-Cueto[1]*, M Almanza[2] and PW Kolsteren[1]

[1]*Nutrition and Child Health Unit, Department of Public Health, Prince Leopold Institute of Tropical Medicine, Nationalestraat 155, Antwerpen, Belgium; and* [2]*Responsible of the Health and Sexuality Inter-Sectors Programme, Ministry of Education, Calle Cap. Ravelo 2329, Piso 4, La Paz, Bolivia*

Objective: To describe the prevalence of overweight, obesity and being thin in adolescents of La Paz City, Bolivia.
Design: Cross-sectional study, clustered sampling.
Setting: La Paz, Bolivia, August–September 2003.
Subjects: Height and weight of 525 adolescents (mean age 16 y; s.d. ±1.3) attending public and private schools were measured; sociodemographic characteristics were assessed with a short questionnaire.
Results: The present study reveals that 9.3% (±2.5) of the sample are thin adolescents; 19.8% (±3.4) is the overall prevalence of overweight and 2.3% (±1.3) the overall prevalence of obesity. The odds of being thin were higher among those working ($P=0.03$) and among those of higher age ($P<0.001$). The odds of being overweight were higher among female subjects ($P<0.001$). The odds of being obese were higher among younger adolescents ($P=0.046$) and among the more wealthy ones ($P=0.044$).
Conclusions: A large prevalence of 22% overweight/obesity in adolescents from La Paz City was observed. The findings support the need of enhanced nutritional surveillance and interventions particularly in female adolescents.
European Journal of Clinical Nutrition (2005) **59,** 82–87. doi:10.1038/sj.ejcn.1602040
Published online 11 August 2004

Keywords: adolescents; overweight; Bolivia; underweight; BMI; nutritional transition; obesity; prevalence

Introduction

Both the short- and long-term adverse effects of overweight and underweight in childhood and adolescence have been well documented (Must *et al*, 1992; Must, 1996; Freedman and Perry, 2000; Kiess *et al*, 2001). However, adolescents have been set aside from many Population Health Surveys, as nutritional status is only assessed in children under 5 y and women who have had a child in the previous 3–5 y, justifying a specific call for research in this age group at a global level (de Onis and Blössner, 2000).

Obesity in childhood and adolescence predicts adverse health outcomes in adulthood (Freedman and Perry, 2000; Raman, 2002). Adolescent obesity forecasts adult obesity (Dietz and Gortmaker, 2001), a predictor of chronic diseases (Caroli and Lagravinese, 2002; Swinburn *et al*, 2004) such as cardiovascular disease, type II diabetes (Goran *et al*, 2003), the metabolic syndrome (Vanhala *et al*, 1998), oesophagus, colorectal, breast, endometrial and kidney cancers (Bianchini *et al*, 2002; Key *et al*, 2004). In the US, for example, 60% of overweight children present already one risk factor such as hyperlipidemia, hypertension or high blood pressure, and more than 20% have two or more risk factors (Dietz and Gortmaker, 2001; Dietz, 2004).

In Latin America, the prevalence of undernutrition-related problems is decreasing while the prevalence of overweight and obesity is increasing, even among native groups (Filozof *et al*, 2001; Peña and Bacallao, 2001; Kain *et al*, 2002). In Bolivia, the only available data concerning anthropometry of adolescents are the regular Development and Health

***Correspondence: A Pérez-Cueto, Nutrition Unit, Prince Leopold Institute of Tropical Medicine, National estraat 155, 2000 Antwerpen, Belgium.**
E-mail: aperezcueto@itg.be
Guarantor: **A. Pérez-Cueto.**
Contributors: **AP designed the study, coordinated the execution of the survey, performed the data management and analysis and was responsible for the writing of the manuscript. MA participated in the execution of the survey and gave critical comments on the design, methodology and final contents of the paper. PWK coordinated the study, participated in the design and contributed substantially to the contents of the paper.**
Received 31 January 2004; revised 10 June 2004; accepted 22 June 2004; published online 11 August 2004

Surveys (DHS). However, these surveys only record anthropometric data for female individuals who have had a child in the past 3–5 y (Instituto Nacional de Estadística (INE), 1994, 1998; Martorell *et al*, 1998). Therefore, the estimation of prevalence of overweight among the age group 13–18 y might be confounded by the recent birth and breastfeeding practices. Our previous analysis of the raw data of the Bolivian Health Surveys 1994 and 1998 suggests that an important increase in overweight of 10% points has occured in a 4-y period in women of childbearing age (Pérez-Cueto and Kolsteren, 2004). Some small-scale studies performed in the 1990s showed that the problem of stunting is still a concern, both in children 10–12 y (Slooten *et al*, 1994; Post *et al*, 1994) and young adults (Guzmán *et al*, 1996) who may also be at risk of chronic diseases if they become obese later in adulthood.

Therefore, the present study concentrates in describing the nutritional status of a sample of adolescents living in the Bolivian capital city of La Paz, for which no information is available at present.

Methodology

The sample size was calculated for an expected prevalence of 20% overweight, with a precision of 5% and 95% CI. A design effect of 2.1 was introduced to prevent bias due to the clustering. Using Epi-Info v. 6.0 Software, a total number of 517 individuals was obtained to produce the minimal sample size. The expected prevalence was obtained from the published results of the 1994 DHS (Instituto Nacional de Estadística, 1994), where 21% of the total sample of women could be considered overweight (BMI $>25\,kg/m^2$). Schools were randomly selected from the Bolivian Ministry of Education's list using computer-generated random numbers. Schools without Secondary Level were eliminated, and replaced by the following number on the list. Both public and private schools were considered in the sampling. Each school was visited 1 week prior to the survey. The questionnaire and measurement methods were explained in detail to the Directors and teachers. Then in each school, classrooms were again randomly selected. On the day of the interview, students received a detailed explanation of the study and were free to participate or to refuse participation. Every student present at the time of the interview was surveyed. Each student gave written consent to participate in the survey and the Ministry of Education provided the ethical approval. Therefore, 595 adolescents in the last 5 y of school were surveyed; a trained physician following standard procedures (WHO, 1995) measured height and weight. A self-administered questionnaire was used to obtain socio-demographic characteristics. Students were kept in their classroom with the interviewers, a trained physician and a trained nutritionist, and clear explanations were given to each question. Teachers helped in the process of communication with students. Students could ask for clarifications (only once a word was reported as not being understood by a female adolescent of 14 y). The questions were based on standard population survey questions, since in Bolivia, the Household Surveys' 1999–2002 included individual responses of children starting at an age of 7 y (Instituto Nacional de Estadística, 1999).

Students with missing data on age ($n=18$), and those over 18 y ($n=17$) and below 13 y ($n=6$) were excluded from the analysis. One woman in her second trimester of pregnancy was not included in the final analysis. Hence, data of 525 students were retained for analysis (88% of all interviewed). The International Obesity Task Force's (IOTF) recommended cutoff points for the body mass index (BMI)-for-age (Cole *et al*, 2000) were used to classify overweight and obesity, while thinness was considered if BMI $<18.5\,kg/m^2$ (INE LPB, 1994, 1998) in order to allow for comparisons within the country. Stunting was defined according to the WHO's recommendations (WHO, 1983, 1995). 'Age' was calculated from the reported date of birth of the respondent to the day of interview. Statistical analyses were performed with SPSS v. 11.5 and Intercooled Stata v. 7 Softwares. Differences in prevalence were assessed using the Pearson's χ^2. ANOVA was used to compare the gender differences in age and anthropometric characteristics. Normality of data was assessed with the Kolmogorov–Smirnof Test. BMI ($P=0.089$) and 'weight' ($P=0.181$) were normally distributed while overweight, thinness and obesity presented a Poisson distribution ($P>0.9$). Preliminary analysis of the data showed that the categories of occupation of the father 'retired' and 'unemployed' were not significantly associated to being thin, overweight or obese in this sample of Bolivian adolescents (Overall $P=0.652$). Therefore, and only for the purpose of the present paper, these categories have been merged under 'not economically active'. Logistic Regression models were fitted in order to determine the predictors of being thin, overweight and obese. Each of them was included in the model as a dichotomous-dependent variable. 'Age' and 'Pocket money available' were introduced as covariates. 'School year' (8th Grade Primary, 1–4th Grades Secondary), 'Type of school' (private–public), 'Language spoken at home' (Spanish, Aymara, other), 'Occupation of the Father' (manual, nonmanual, not economically active) and 'Occupation of the Mother' (manual, nonmanual, housewife) and 'Working status of the student' (yes, no) were included as categorical variables. To determine which variable was to be kept in the final model, a backward conditional procedure was used. Removal of variables was at $\alpha>0.05$ for the Wald test. The Hosmer and Lemeshow Goodness-of-Fit test was used to assess whether the model's estimates fit the data at an acceptable level (Bender and Grouven, 1996). The *P*-values less than 0.05 were considered significant.

Results

Table 1 shows the age and anthropometric characteristics of a sample of 525 adolescents from La Paz, by Gender and School Grade. Gender differences in height, weight and BMI

Table 1 Age and anthropometric characteristics of a sample of 525 adolescents from La Paz, by gender and School Grade. Values are given as means (standard deviation) for age (y), height (cm), weight (kg) and body mass index (kg/m^2)

	Boys[a]					Girls[a]				
	Boys N percent (%)	*Mean age in years (s.d.)*	*Mean weight in kg (s.d.)*	*Mean height in cm (s.d.)*	*Mean BMI in kg/m^2 (s.d.)*	*Girls N percent (%)*	*Mean age in years (s.d.)*	*Mean weight in kg (s.d.)*	*Mean height in cm (s.d.)*	*Mean BMI in kg/m^2 (s.d.)*
Eighth grade primary	50 (54)	13.9 (0.5)	54.9 (10.6)	160.7 (8.5)	21.2 (3.6)	43 (46)	13.9 (0.5)	52.4 (8.0)	154.7 (5.2)	21.8 (2.8)
First grade secondary	35 (31)	15.0 (0.9)	54.7 (10.1)	161.2 (6.6)	20.9 (2.8)	78 (69)	15.0 (0.8)	52.7 (8.2)	153.6 (5.6)	22.4 (3.2)
Second grade secondary	55 (53)	15.7 (0.8)	54.9 (7.0)	162.9 (6.3)	20.7 (2.2)	49 (47)	15.8 (0.7)	51.1 (7.0)	150.6 (5.0)	22.5 (2.6)
Third grade secondary	55 (43)	16.8 (0.7)	60.0 (8.7)	164.8 (6.1)	22.1 (3.0)	74 (57)	16.8 (0.6)	54.9 (7.4)	153.8 (5.6)	23.2 (2.8)
Fourth grade secondary	43 (50)	17.4 (0.5)	59.9 (7.2)	166.1 (6.2)	21.7 (1.9)	43 (50)	17.4 (0.5)	54.1 (7.1)	153.4 (5.2)	22.9 (2.6)
Total	238 (45)	16.0 (1.4)	57.2 (8.8)	163.5 (6.8)	21.4 (2.7)	287 (55)	16.0 (1.3)	53.3 (7.6)	153.2 (5.5)	22.7 (2.9)

[a]Differences in height, weight and BMI are statistically different between genders (ANOVA $P<0.001$); age was the same (ANOVA $P=0.9$).

were observed. Boys tend to be taller and thinner than girls between 13 and 18 y of age. Distribution of adolescents according to gender and course level was balanced. The age of male adolescents was not different from the age of female students. Table 2 illustrates the prevalence of being thin, overweight and obese by gender and type of school in a sample of 525 adolescents of La Paz, Bolivia. The only statistically significant gender difference was found in the prevalence of overweight, which is 14% points higher in girls than in boys. Surprisingly, significantly more adolescents attending private schools were found to be thinner than those attending public schools ($P=0.00013$); however, the differences in overweight and obesity were not significant between types of school. A high prevalence of stunting of 35% ($\pm$4.1) was found in the sample of secondary school adolescents (data on stunting are not shown in the tables). Table 3 shows the odds ratio of being thin, overweight and obese in a sample of 525 adolescents of La Paz, according to the sociodemographic variables that were retained by the backward procedure applied to perform the Binary Logistic Regression. The odds of being thin were higher among those working ($P=0.03$) and among those of a higher age ($P<0.001$). The odds of being overweight were higher among female subjects ($P<0.001$). The odds of being obese were higher among younger adolescents ($P=0.046$) and among the more wealthy ones ($P=0.044$). In all three cases, the Hosmer and Lemshow Goodness–of–Fit tests yield a *P*-value greater than 0.05, implying that the model's estimates fit the data at an acceptable level.

Discussion

According to the design of the study, the minimum required number of observations was 517. Even after exclusion of uncompleted questionnaires, this number was still achieved. Therefore, the sample allows to infer the findings to the mother population and to describe the nutritional status of adolescents attending secondary schools in La Paz. To the knowledge of the authors, this study is the first one to describe the prevalence of being thin, overweight and obese in a sample of adolescents living in La Paz, Bolivia.

The controversy on the classification systems of childhood and adolescent overweight and obesity is still ongoing, however, and despite its limitations, the IOTF reference is gaining increasing acceptance (Neovius *et al*, 2004). In fact, if compared, the prevalences of overweight and obesity obtained applying the IOTF and the WHO's cutoff points of BMI-for-age will yield similar results (Wang and Wang, 2002). Although the use of the IOTF reference may slightly overestimate overweight and underestimate the prevalence of obesity, the differences were not statistically significant, for example, in a Greek sample (Karayiannis *et al*, 2003). Furthermore, the IOTF reference (Cole *et al*, 2000) has been suggested to be appropriate for the identification of overweight and obesity since the proposed cutoffs are a result of

Table 2 Prevalence of being thin, overweight and obese by gender and type of school in a sample of 525 adolescents of La Paz, Bolivia

	Gender			*Type of school*			
Nutritional status	*Boys prevalence (95% CI)*	*Girls prevalence (95% CI)*	*P-value of the difference between boys and girls*[c]	*Private school prevalence (95% CI)*	*Public school prevalence (95% CI)*	*P-value of the difference between type of schools*[c]	*Total prevalence (95% CI)*
Thin[a]	11.8 (7.7–15.9)	7.3 (4.3–10.3)	0.08	15.1 (10.4–19.8)	5.2 (2.7–7.7)	<0.001	9.3 (6.8–11.8)
Normal	72.7 (67.0–78.4)	65.2 (59.7–70.7)	0.06	62.6 (56.2–69.0)	72.9 (67.9–77.9)	0.012	68.6 (64.6–72.6)
Overweight[b]	12.2 (8.0–16.4)	26.1 (21.0–31.2)	<0.001	20.1 (14.8–25.4)	19.6 (15.2–24)	0.89	19.8 (16.4–23.2)
Obesity[b]	3.4 (1.1–5.7)	1.4 (0–2.8)	0.13	2.3 (0.3–4.3)	2.3 (0.6–4.0)	0.99	2.3 (1.0–3.6)

[a]Being 'Thin' defined as BMI $<18.5\,kg/m^2$ (INE, 1994, 1998).
[b]Overweight and obesity were defined using the IOTF cutoff points (Cole *et al*, 2000).
[c]χ^2 test of two proportions at the 0.05 level.

Table 3 Odds ratio of 'being thin', 'overweight' and 'obese' according to sociodemographic characteristics in a sample of 525 adolescents attending secondary schools in La Paz, Bolivia[a]

Associated variables	*OR (95% CI)*	P–*value*
Being thin H&L = 0.381		
Age[b]	0.44 (0.31–0.63)	<0.001
Working status		
Work (reference)	1	
Do not work	0.21 (0.05–0.86)	0.030
Overweight H&L = 0.998		
Gender		
Male (reference)	1	
Female	3.70 (1.99–6.85)	<0.001
Obesity H&L = 0.996		
Age[b]	0.41 (0.17–0.98)	0.046
Daily pocket money[b]	1.16 (1.00–1.34)	0.044

[a]Adjusted for school level, age, gender, type of school, language spoken at home, occupation of the father, occupation of the mother and daily pocket money.
[b]Increment for age 1 y.
[c]Increment for daily pocket money: 1 Boliviano.
H&L: *P*-value of the Hosmer and Lemshow Goodness-of-Fit Test.

the analysis of international pooled data and therefore constitute the best instrument available to date for epidemiological studies (Woodruff and Duffield, 2002; Wang and Wang, 2002).

One of the characteristics of the nutritional transition is the coexistence of overweight and underweight in the same population (Doak *et al*, 2002). The present study shows that both overweight and obesity are now significantly prevalent in a society where undernutrition was the main public health concern, and allows to state that Bolivia is undergoing further steps of the nutritional transition (Table 2). The present results show that 9.3% of the adolescents in the sample were thin, which is similar to the observed prevalence in Brazil, a neighbouring country (Wang *et al*, 2002). However, it is still higher than the reported prevalence for Bolivian adolescent mothers who show only 3% prevalence of thinness (INE, 1998). 35% of the sample could be considered stunted using the WHO's Reference (WHO, 1995). This value triples the reported prevalence of stunting in women of 15–19 y who had had a child in the previous 3 y (INE, 1998); however, applying to our data the single cutoff point of 145 cm for height that is regularly used by the Bolivian National Institute of Statistics, this value is reduced to 3.4% and becomes three times lower than the reported one. These discrepancies support the need to develop further references that may be of more pertinence for adolescents in developing countries (Woodruff and Duffield, 2002; Neovius *et al*, 2004). The present study found that 4% more boys can be considered as thin when compared with girls. Although the difference is marginally significant ($P=0.08$), the observation is in agreement with previous reports on Brazilian, Chinese, Russian (Wang *et al*, 2002) and Egyptian teenagers (Galal, 2002), where a higher BMI could be observed in teenage girls. Overall, overweight is almost 20% in this sample of adolescents from La Paz, but this is mainly explained by the high prevalence among female adolescents. A separate analysis of the Bolivian DHS 1998 Survey's Subset of data for girls between 15 and 17 y in the city of La Paz was performed in order to validate the present results. Although DHS provides data only in girls who have had a child in the previous 3 y (hence a different population), the prevalence of overweight was found to be of a similar size (data not shown). The results described in this paper are furthermore in agreement to previous reports for Brazil (Neutzling *et al*, 2000) and East Germany (Frye and Heinrich, 2003), but apparently in other countries the contrary is observed (Kautiainen *et al*, 2002; Savva *et al*, 2002), where boys tend to be more overweight than girls, hence impeding generalisation.

Although sexual maturation was not assessed in this study, the inverse association between obesity and age agrees with a previous report where higher rates of obesity were observed in girls around the time of menarche (Kimm and Obarzanek, 2002).

The association found between being thin and working status of adolescents may reflect that the income of those adolescents who combine working with studies is not enough to cover their subsistence needs. Many of them are

maids (girls) in the houses of richer people, or helpers in the public transport (boys), both with a very heavy workload and little time for eating, studying and rest. However, the stunting levels bring the attention to the food shortage these particular group of adolescents may be systematically facing despite the efforts of the Bolivian Government to provide a free breakfast (morning schools) or snack (afternoon schools). In agreement, but in the other side of the 'working status', each extra Bolivian Boliviano of pocket money available increases the risk of obesity by 16% among nonworking adolescents. Nevertheless, further research is needed to better understand the determinants of food choices made by adolescents of school age in Bolivia.

School attendance in Bolivia is compulsory only during the first 8 y of school (primary level). Secondary education is therefore voluntary, but most of the children living in urban areas will finalise the Secondary cycle. La Paz is the city with higher levels of attendance in secondary schools both public and private (Instituto Nacional de Estadística, 2003). Since the 'type of school' was not significantly associated ($P > 0.05$) to the nutritional status of this sample of adolescents (Table 3) after controlling for the effects of the other variables, it is not likely that this could be a source of bias in the results that have been presented.

Adolescent BMI predicts cardiovascular risk in later life (Raman, 2002; Jeffreys *et al*, 2003; Oren *et al*, 2003). Even more, overweight in adolescence has been suggested as a more powerful predictor of morbidity risks than overweight in adulthood (Must *et al*, 1992; Dietz, 2004). Therefore, the present findings suggest that female adolescents living in La Paz may be almost four times more at risk of obesity and hence to chronic disease later in life than their male peers, and that the high prevalence of overweight may affect their later social and economic status (Gortemaker *et al*, 1993; Sobal, 1994).

The present study supports the plea to develop improved references for the assessment of the nutritional status of adolescents in developing countries (Woodruff and Duffield, 2002). The WHO's references have been criticised because of the risk of misclassification of individuals, which can be translated as a combination of over consumption of health resources by individuals at lower health risk and under consumption by those most at risk (Neovius *et al*, 2004).

Since the present study was performed only in one Bolivian setting, future research activities should target adolescents at a national level in order to first, describe the current nutritional status of this population group, and second, to better understand the underlying reasons of the prevalence of underweight, overweight and obesity focusing on food intake and physical activity.

In conclusion, a prevalence of 20% overweight and 2.3% obesity was observed in a sample of 525 adolescents from La Paz City. These figures reveal the ongoing nutritional transition, while supporting the need of enhanced nutritional surveillance and interventions in this age group, particularly in girls.

Acknowledgements

This study was partially sponsored by *Nutrition Tiers Monde*, a Belgian Non-Profit Organisation. The Bolivian Ministry of Education gave the Ethical Approval to the study. The Bolivian Non-Profit Association '*Promoción Investigación y Acción Social para el Desarrollo*' (*PIAS*) collaborated with the fieldwork. We are thankful to Dr Augusto Saavedra for the anthropometric measurements. We thank the Directors, Teachers and Students from the following Schools: 'Martín Cárdenas' (Auquisamaña & E1 Alto), 'Santa Rosa', 'Dora Schmidt', 'San Calixto', 'Vida y Verdad', 'Instituto Americano' (Convenio) and 'David Pinilla' for their participation in the study.

References

Bender R & Grouven U (1996): Logistic regression models used in medical research are poorly presented. *BMJ* **313**, 628.

Bianchini F, Kaaks R & Vainio H (2002): Overweight, obesity, and cancer risk. *Lancet Oncol*. **3**, 565–574.

Caroli M & Lagravinese D (2002): Prevention of obesity. *Nutr. Res*. **22**, 221–226.

Cole TJ, Bellizzi MC, Flegal KM & Dietz WH (2000): Establishing a standard definition for child overweight and obesity worldwide, international survey. *BMJ* **320**, 1240–1243.

de Onis M & Blossner M (2000): Prevalence and trends of overweight among preschool children in developing countries. *Am. J. Clin. Nutr.* **72**, 1032–1039.

Dietz WH (2004): Overweight in Childhood and Adolescence. *N. Engl. J. Med*. **350**, 855–857.

Dietz WH & Gortmaker SL (2001): Preventing obesity in children and adolescents. *Annu. Rev. Publ. Health* **22**, 337–353.

Doak C, Adair L, Bentley M, Fengying Z & Popkin B (2002): The underweight/overweight household: an exploration of household sociodemographic and dietary factors in China. *Public Health Nutr.* **5**, 215–221.

Filozof C, Gonzalez C, Sereday M, Mazza C & Braguinsky J (2001): Obesity prevalence and trends in Latin-American countries. *Obes. Rev.* **2**, 99–106.

Freedman DS & Perry G (2000): Body composition and health status among children and adolescents. *Prev. Med.* **31**, S34–S53.

Frye C & Heinrich J (2003): Trends and predictors of overweight and obesity in East German children. *Int. J. Obes. Relat. Metab. Disord*. **27**, 963–969.

Galal OM (2002): The nutrition transition in Egypt: obesity, undernutrition and the food consumption context. *Public Health Nutr.* **5**, 141–148.

Goran M, Ball G & Cruz M (2003): Obesity and risk of type 2 diabetes and cardiovascular disease in children and adolescents. *J. Clin. Endocrinol. Metab*. **88**, 1417–1427.

Gortmaker SL, Must A, Perrin JM, Sobol AM & Dietz WH (1993): Social and economic consequences of overweight in adolescence and young adulthood. *N. Engl. J. Med*. **329**, 1008–1012.

Guzmán M, Arze RM & Lopez R (1996): Estado Nutricional de estudiantes ingresantes a la Fcultad de Medicina, Enfermería, Nutrición y Tecnología Médica. Gestión — 1996. Ref Type, Internet Communication at: http://ww.umsalud.edu.bo/carreras/Nutricion/investigacion/resumen002.htm accessed 09/07/2003.

Instituto Nacional de Estadística (INE) (1999): *Encuesta Contínua de Hogares*. Documento Metodológico. pp 1–34. INE: La Paz.

Instituto Nacional de Estadística (INE) (2003): *Bolivia: Características Educativas y cambios entre 1992 y 2001* pp 50–55. INE: La Paz.

Instituto Nacional de Estadística (INE) LPB (1994): *Encuesta nacional de demografía y salud 1994* pp 1–252. Calverton: Macro International Inc.

Instituto Nacional de Estadística (INE) LPB (1998): *Encuesta nacional de demografía y salud 1998* pp 1–350. Calverton: Macro International Inc.

Jeffreys M, McCarron P, Gunnell D, McEwen J & Davey Smith G (2003): Body Mass Index in early and mid-adulthood, and subsequent mortality, a historical cohort study. *Int. J. Obes. Relat. Metab. Disord.* **27**, 1391–1397.

Kain J, Uauy R, Vio F & Albala C (2002): Trends in overweight and obesity prevalence in Chilean children, comparison of three definitions. *Eur. J. Clin. Nutr.* **56**, 200–204.

Karayiannis D, Yannakoulia M, Terzidou M, Sidossis LS & Kokkevi A (2003): Prevalence of overweight and obesity in Greek school-aged children and adolescents. *Eur. J. Clin. Nutr.* **57**, 1189–1192.

Kautiainen S, Rimpela A, Vikat A & Virtanen SM (2002): Secular trends in overweight and obesity among Finnish adolescents in 1977–1999. *Int. J. Obes. Relat. Metab. Disord.* **26**, 544–552.

Key TJ, Schatzkin A, Willet WC, Allen NE, Spencer EA & Travis RC (2004): Diet, nutrition and the prevention of cancer. *Public Health Nutr.* **7**, 187–200.

Kiess W, Galler A, Reich A, Müller G, Kapellen T, Deutscher J, Raile K & Kratzsch J (2001): Clinical aspects of obesity in childhood and adolescence. *Obes Rev* **2**, 29–36.

Kimm S & Obarzanek E (2002): Childhood obesity, a new pandemic of the new millenium. *Pediatrics* **110**, 1003–1006.

Martorell R, Khan LK, Hughes ML & Grummer-Strawn LM (1998): Obesity in Latin American women and children. *J. Nutr.* **128**, 1464–1473.

Must A (1996): Morbidity and mortality associated with elevated body weight in children and adolescents. *Am. J. Clin. Nutr.* **63**, 445S–447S.

Must A, Jacques PF, Dallal GE, Bajema CJ & Dietz WH (1992): Long-term morbidity and mortality of overweight adolescents. A follow-up of the Harvard Growth Study of 1922 to 1935. *N. Engl. J. Med.* **327**, 1350–1355.

Neovius M, Linné Y, Barkeling B & Rössner S (2004): Discrepancies between classification systems of childhood obesity. *Obes. Rev.* **5**, 105–114.

Neutzling MB, Taddei JA, Rodrigues EM & Sigulem DM (2000): Overweight and obesity in Brazilian adolescents. *Int. J. Obes. Relat. Metab. Disord.* **24**, 869–874.

Oren A, Vos LE, Uiterwaal C, Gorissen W, Grobbee DE & Bots ML (2003): Change in body mass index from adolescence to young adulthood and increased carotid intima-media thickness at 28 years of age, The atherosclerosis risk in young adults study. *Int. J. Obes. Relat. Metab. Disord.* **27**, 1383–1390.

Peña M & Bacallao J (2001): La obesidad y sus tendencias en la región. *Rev. Panam. Salud. Publica* **10**, 75–78.

Pérez-Cueto A & Kolsteren P (2004): Changes in the nutritional status of Bolivian women 1994–1998. Demographic and social predictors. *Eur. J. Clin. Nutr.* **58**, 660–666.

Post G, Lujan C, San Miquel J & Kemper H (1994): The nutritional intake of Bolivian boys. The relation between altitude and socioeconomic status. *Int. J. Sports Med.* **15**, S100–S105.

Raman RP (2002): Obesity and health risks. *J. Am. Coll. Nutr.* **21**, 134S–139S.

Savva SC, Kourides Y, Tornaritis M, Epiphaniou-Savva M, Chadjigeorgiou C & Kafatos A (2002): Obesity in children and adolescents in Cyprus. Prevalence and predisposing factors. *Int. J. Obes. Relat. Metab. Disord.* **26**, 1036–1045.

Slooten J, Kemper H, Post G, Lujan C & Coudert J (1994): Habitual physical activity in 10- to 12-year-old Bolivian boys. *Int. J. Sports Med.* **15**, S106–S111.

Sobal J (1994): Social and economic consequences of overweight in adolescence. *N. Engl. J. Med.* **330**, 647.

Swinburn BA, Caterson I, Seidell JC & James WP (2004): Diet, nutrition and the prevention of excess weight gain and obesity. *Public Health Nutr.* **7**, 123–146.

Vanhala M, Vanhala P, Kumpusalo E, Halonen P & Takala J (1998): Relation between obesity from childhood to adulthood and the metabolic syndrome: population based study. *BMJ* **317**, 319.

Wang Y, Monteiro C & Popkin B (2002): Trends of obesity and underweight in older children and adolescents in the United States, Brazil, China, and Russia. *Am. J. Clin. Nutr.* **75**, 971–977.

Wang Y & Wang JQ (2002): A comparison of international references for the assessment of child and adolescent overweight and obesity in different populations. *Eur. J. Clin. Nutr.* **56**, 973–982.

WHO (1983): *Measuring Change in Nutritional Status* pp 1–101. Geneva: WHO.

WHO (1995): Expert Committee. *Physical Status, The Use and Interpretation of Anthropometry* WHO Technical Report Series 854, pp 1–453. Geneva: WHO.

Woodruff B & Duffield A (2002): Anthropometric assessment of nutritional status in adolescent populations in humanitarian emergencies. *Eur. J. Clin. Nutr.* **56**, 1108–1118.