Original Article

The National Survey on the Constitution and Health of Chinese Students in 1995: Nutritional status of school students aged 10–17 years in Shaanxi, China*

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There are 200 million Chinese adolescents and they represent a significant proportion of the world adolescent population. Their health, growth and nutritional status is of vital importance to China but also to the health of adolescents globally. Previous assessments of nutritional status of adolescents in China have been undertaken without using World Health Organization (WHO) recommended anthropometric methods or reference data. Using data from the National Survey on the Constitution and Health of Chinese Students in 1995 (NSCHCS-95), this study aimed to assess the current nutritional status of Shaanxi school students using WHO recommended methods of nutritional assessment. Data for 6284 (3142 females and 3142 males) Shaanxi school students aged 10–17 years was abstracted from the Shaanxi portion of the NSCHCS-95. This national cross-sectional survey gathered anthropometric measurements using standard methods, maturity indicators, and basic social and demographic data. The calculation of anthropometric indicators was based on the National Centre for Health Statistics/WHO reference data and the prevalence of nutritional status indicators was estimated using standard WHO recommended cut-offs and methods of maturity adjustment. The median age of menarche and spermarche was delayed for Shaanxi rural female and male students in comparison with the reference data by 0.81 and 0.39 years, respectively. The prevalence of stunting and thinness in students in almost all ages was higher than in the reference population. For all age groups combined, the adjusted prevalence of stunting was 8.0% for urban students, and 11.0% for rural students. For students under 14 years of age, the adjusted prevalence of thinness was 18.3% for urban students, and 15.1% for rural students. The prevalence of 'at risk of overweight' and obesity among urban male students aged 10–11.99 (for overweight) and 10–12.99 years (for obesity) were similar to the reference population. Undernutrition (stunting and thinness) continues to be a public health problem in the Shaanxi school population and may be related to the less developed rural economy in the province. Young Shaanxi urban male students showed a tendency towards an excess prevalence of 'at risk of overweight' and obesity, which may be related to improved economic conditions in urban areas. It is necessary to develop national anthropometric reference data, cut-off points and median ages of attainment of WHO recommended maturational indicators for Chinese adolescents.

Key words: adolescents, nutritional status, underweight, overweight, menarche, spermarche, maturation, Shaanxi, China.

Introduction

China is the largest developing country with a population of more than 1.2 billion, of which approximately 200 million are adolescents aged 10–17 years. The health, growth and nutritional status of these Chinese adolescents is of importance to the whole Chinese population as well as to adolescents in the rest of the world. Previous studies have reported that undernutrition and overnutrition persist in most parts of China in spite of improvements in food supplies and health conditions, and in spite of the availability of educational and social services.[1–6]

In order to assess nutritional status and responses to nutritional interventions, as well as to ascertain determinants and consequences of malnutrition, anthropometry has been employed in previous population surveys in China.[2–9] However, only three of these studies focused on adolescents.[5,7,8]

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In these surveys comparisons of medians or means of anthropometric indicators were emphasized rather than the estimation of the prevalence of malnutrition based on various anthropometric indicators.[5] Furthermore, assessment of nutritional status of adolescents in China[5,7,8] was done without using World Health Organization (WHO) recommended[10,11] anthropometric indicators, cut-offs, methods for maturity adjustment nor the NCHS/WHO reference data. Use of the international growth reference allows comparison of results among populations of different nutrition and health status and thus greatly assists in the interpretation of anthropometric survey results.[12]

The data used in this study were abstracted from the Shaanxi data set of the National Survey on the Constitution and Health of Chinese Students in 1995 (NSCHCS-95), which was a cross-sectional survey designed with the aims of firstly, assessing the current nutrition and health status of Chinese school students aged 7–22 years, and secondly, measuring the change in the health and nutrition of these students when compared with results of a similar study conducted 10 years earlier called 'NSCHCS-85'. This paper reports on the current nutritional status and prevalence of stunting, thinness, 'at risk of overweight' and obesity of Shaanxi school students aged 10–17 years using the NCHS/WHO reference and WHO recommendations for nutritional assessment of adolescents.

Materials and methods

Subjects

A stratified multistage cluster sample of school students aged 10–17 years was taken from 10 administrative districts in Shaanxi province. Districts were classified according to socioeconomic level, with emphasis on health and education, into three strata of poor, middle and good levels. Each of these three selected administrative districts was divided into urban and rural areas. The primary, middle and high schools were randomly selected from each of these six areas. In a given school, a random sample of a prespecified number of classes was selected from each grade. All students of the selected classes were invited to participate.

The inclusion criteria for study subjects were male and female students aged 10–17 years who were enrolled in the selected public primary or secondary schools in 1995, who were permanent residents in the selected areas, who were of the Han ethnic group, and who had agreed to be interviewed, examined and measured. The exclusion criteria for study subjects included adolescents with heart disease, hypertension, pulmonary tuberculosis, asthma, hepatitis and nephritis; those with abnormal growth (e.g. dwarfism, gigantism); those with disabilities such as severe scoliosis and kyphosis, lameness, genu varum and genu valgum; those who had suffered from acute diseases, high fever or diarrhoea within the last month; females in menstruation at the time of examination; and those from specialist athletic and actor training classes.

Measurement and data collection were conducted during a 3 month period between April and June 1995. Chronological age was determined by subtracting the birth date from the date of measurement. Subjects' registration certificate, a government issued statement of area of permanent residence, was used to validate urban/rural status.

Anthropometric measurements

A stadiometer with accuracy of measurement of 0.1 cm was used to measure height. The subject stood fully erect and barefoot on a flat surface with arms hanging freely by the sides, heels together, and an angle of about 60° between the medial borders of the feet. A beam scale was used to weigh to the nearest 0.1 kg. The students were dressed in minimal clothing. Body mass index (BMI) was calculated as weight (kg)/height^2 (m^2). Using a standard method the median of three readings from a skinfold calliper was used to measure the triceps skinfold thickness (TRSKF) and the subscapular skinfold thickness (SSKF).

All anthropometric measurements were taken by trained anthropometrists using standardized methods and apparatus of the same precision. The scales were regularly checked and if necessary adjusted before each measuring session. Anthropometric measures were repeated on a 3% sample each day by a quality control team. If the proportion of incomplete or mistaken items (e.g. > 0.5 cm difference for height or > 0.1 kg difference for weight) was greater than 10%, all subjects for that day were re-measured.

Measurements of maturational indicators

Menarche status was determined by a female physician or pediatrician who interviewed each female student, asking whether or not she had begun to menstruate and if she was currently menstruating. Spermarche status was determined by a male physician or pediatrician who interviewed each male student, asking whether or not he had begun to have onset of spontaneous ejaculations.

Data management and analysis

FoxBase (Microsoft, Seattle, WA, USA) was used to manage data files and STATA (STATA Corporation, Texas, USA) was employed in data analysis. Trained computer clerks entered the data by a duplicate data entry method. Based on WHO recommendations for anthropometric assessment of adolescents,[11] stunting (or low height-for-age) was defined as height-for-age < 3rd percentile of the NCHS/WHO reference data;[10] thinness (or low BMI-for-age) was defined as a BMI-for-age < 5th percentile of the NCHS/WHO reference data;[11] 'at risk of overweight' was defined as a BMI-for-age ≥ 85th percentile BMI of the NCHS/WHO reference data;[11] obesity was defined as a BMI-for-age ≥ 85th percentile BMI, a TRSKF-for-age ≥ 90th percentile TRSKF, and an SSKF-for-age ≥ 90th percentile SSKF of the NCHS/WHO reference data.[11] The prevalence estimates for stunting, thinness, 'at risk of overweight' and obesity are presented by chronological age in 1 year intervals. Median ages of menarche and spermarche were estimated using the logistic model[11,13] and the 95% confidence intervals for the median were calculated using the simple version of Fieller's formula.[14]

Median age at menarche was employed for maturity adjustment of anthropometric measurements of female students as recommended by WHO.[11] Median age at spermarche was used for maturity adjustment for male students. However, age of onset of spermarche is not included in the WHO reference data. The reference value of mean age of spermarche was obtained from a survey of 150 Israeli adolescents and was used for maturity adjustment together with the NCHS/WHO reference.[15] Maturity adjustment was done by

subtracting from or adding to the chronological age of each student the difference between the sample age at menarche (or spermarche) and the reference age of menarche (or spermarche). Anthropometric measurements for subjects were then compared with the reference at the maturity adjusted age.

The 95% confidence intervals for the prevalence estimates were obtained and compared with the relevant reference values. The Mantel-Haenszel method of combining 2×2 tables was employed to assess the difference in the prevalence between urban and rural students. Age was considered to be a stratification factor. The estimate pooled over all strata of the odds ratio was defined as the ratio of an exposed person having the 'poor' anthropometric indicator to the odds of an unexposed person having the 'poor' anthropometric indicator. A two-tailed significance level of 0.05 was used for the Mantel-Haenszel statistical test.

Results

A total of 6400 eligible students (3200 females and 3200 males) were interviewed and examined. Because of 'missing' or 'wrong' codes, and in particular unclear information about chronological age on their questionnaires, 116 subjects (58 females and 58 males) were dropped from the analysis, leaving 98% of the subjects contributing information to the study.

Median ages of menarche and spermarche

Median ages of menarche and spermarche are shown in Table 1. The median age of menarche and spermarche was delayed for rural students in comparison with the NCHS/WHO reference data. The median age of menarche for Shaanxi rural female students (13.61 years) is greater than the reference by 0.81 years, and the median age of spermarche for Shaanxi rural male students (14.24 years) is greater than Laron's reference value by 0.39 years.[15] There were no significant differences in the median age of menarche and spermarche for Shaanxi urban female and male students and the reference values. The median age of menarche for urban female students is significantly lower than for rural female students by 0.87 years. Similarly, the median age of spermarche for urban male students is significantly lower than for rural male students.

Stunting

Figure 1 shows that the prevalence of stunting was influenced by maturity adjustment in rural students but not in urban students. The unadjusted and adjusted prevalences of stunting were higher than the expected NCHS/WHO reference value of 3% for almost all age groups, except for the unadjusted prevalence for urban male students aged 10–13.99 years, the adjusted prevalence for rural female students 10–11.99 years, and urban male students 10–10.99 years and 13–14.99 years (Table 2 and Fig. 1). For all age groups combined, the unadjusted and adjusted prevalence of stunting was 7.5% and 8.0%, respectively, for urban students, and 19.4% and 11.0%, respectively, for rural students. With maturity adjustment, the odds of stunting for rural female students were not significantly different from the odds for urban female students (M-H combined OR = 1.0, $\chi^2_{\text{M-H}} = 0.05$, $P = 0.82$). However, the odds of stunting for rural male students were 1.9 times higher than the odds for urban male

Table 1. Median ages of menarche and spermarche: Shaanxi students versus references data

	n	Median age[a] (years)	95% confidence interval[b] (years)	Reference (years)
Menarche				
Urban females	1575	12.74	12.63–12.84	12.80[c]
Rural females	1567	13.61	13.50–13.71	12.80[c]
Spermarche				
Urban males	1565	13.80	13.69–13.92	13.85[d]
Rural males	1577	14.24	14.13–14.35	13.85[d]

[a]Calculated by logistic model; [b]calculated by Fieller's formula;[14] [c]NCHS/WHO[11]; [d]Israeli adolescents.[15]

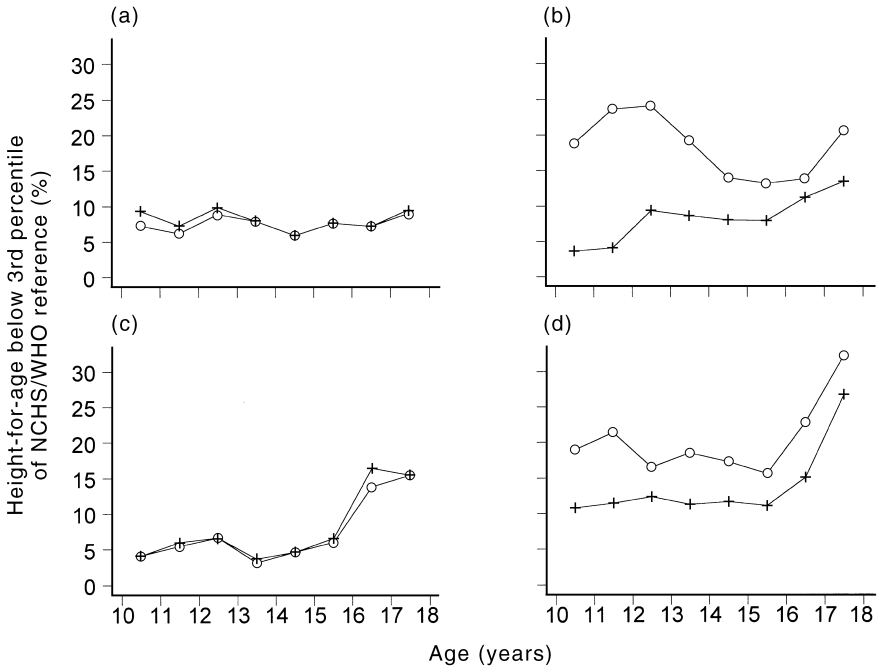

Figure 1. (○) Unadjusted and (+) adjusted prevalence of stunting in (a) urban female students, (b) rural female students, (c) urban male students and (d) rural male students from Shaanxi, China in 1995. NCHS, National Centre for Health Statistics; WHO, World Health Organization.

Table 2. Unadjusted prevalence (%) of stunting (height-for-age < 3rd percentile of NCHS/WHO reference) in Shaanxi students aged 10–17.99 years by sex and urban/rural status

Age (years)	Females *n*	Females Stunting (%)	Females 95% CI	Male *n*	Male Stunting (%)	Male 95% CI
Urban						
10–10.99	193	7.25	4.02–11.87	195	4.10	1.79–7.92
11–11.99	194	6.19	3.24–10.56	201	5.47	2.76–9.58
12–12.99	202	8.91	5.37–13.72	195	6.67	1.16–6.68
13–13.99	190	7.89	4.49–12.69	192	3.12	2.15–8.67
14–14.99	204	5.88	3.08–10.05	193	4.66	3.36–10.94
15–15.99	198	7.58	4.30–12.19	199	6.03	3.15–10.30
16–16.99	186	7.14	3.96–11.69	189	13.76	9.19–19.50
17–17.99	198	9.09	5.48–13.99	201	15.42	10.73–21.17
Rural						
10–10.99	191	18.85	13.56–25.13	195	18.97	13.73–25.19
11–11.99	195	23.59	17.82–30.18	201	21.39	15.94–27.71
12–12.99	183	24.04	18.05–30.90	194	16.49	11.56–22.48
13–13.99	209	19.14	14.04–25.14	195	18.46	13.28–24.63
14–14.99	201	13.93	9.46–19.50	198	17.17	12.19–23.16
15–15.99	190	13.16	8.70–18.81	199	15.58	10.84–21.38
16–16.99	189	13.76	9.19–19.50	193	22.80	17.08–29.37
17–17.99	209	20.57	15.31–26.70	202	32.18	25.79–39.10

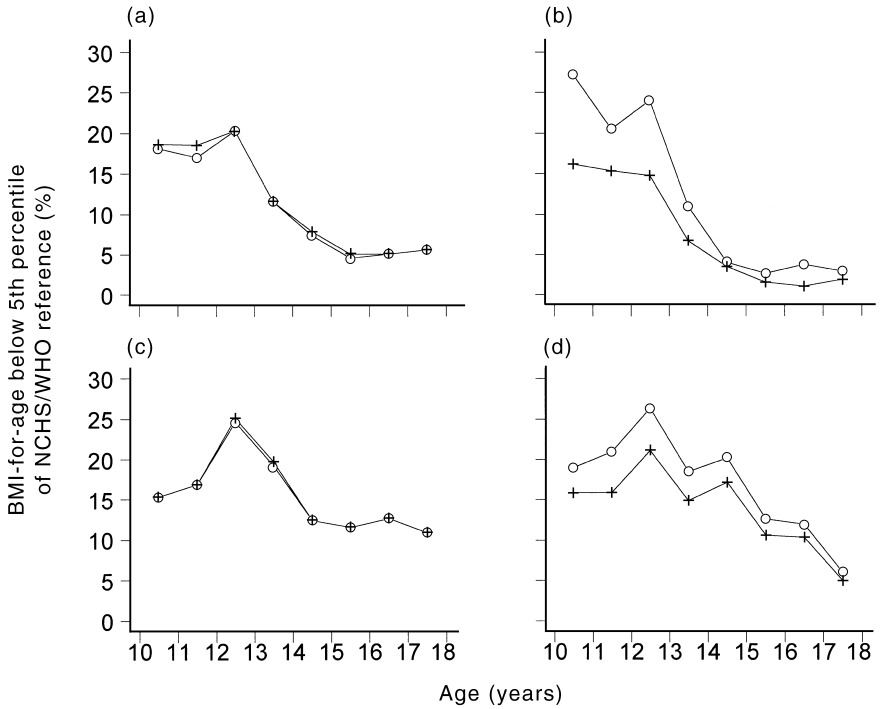

Figure 2. (○) Unadjusted and (+) adjusted prevalence of thinness in (a) urban female students, (b) rural female students, (c) urban male students and (d) rural male students from Shaanxi, China in 1995. BMI, Body mass index; NCHS, National Centre for Health Statistics; WHO, World Health Organization.

students (M-H combined OR = 1.9, $\chi^2_{\text{M-H}} = 28.71$, $P < 0.01$).

Thinness

Figure 2 shows that the prevalence of thinness was influenced by maturity adjustment in rural students but not in urban students. The unadjusted and adjusted prevalence of thinness in Shaanxi female students was higher than the expected NCHS/WHO reference value of 5% for those under 14 years of age (Table 3 and Fig. 2). For students under 14 years of age, the unadjusted and adjusted prevalence of thinness was 17.9% and 18.3%, respectively, for urban students, and 20.9% and 15.1%, respectively, for rural students. For rural female students aged ≥14 years, the unadjusted and adjusted prevalence of thinness was 3.3% and 2.0%, respectively, both much lower than the reference value of 5%. For males the unadjusted and adjusted prevalence of thinness in all Shaanxi students for almost all ages was higher than the NCHS/WHO reference except for rural male students aged 17–17.99 years (Table 3 and Fig. 2). Based on maturity adjustment, the odds of thinness for urban female students were significantly greater than the odds for rural female students (M-H combined OR = 1.6, $\chi^2_{\text{M-H}} = 14.77$, $P < 0.01$). The odds of thinness for urban male students were not significantly different from the odds for rural male students (M-H combined OR = 0.9, $\chi^2_{\text{M-H}} = 1.95$, $P = 0.16$).

'At risk of overweight' and obesity

The unadjusted and adjusted prevalences of 'at risk of overweight' and obesity were lower than the reference values of 15% and 10% (Tables 4 and 5 and Figs 3 and 4) for all age and sex groups except for urban male students aged 10–11.99 years (for unadjusted prevalence of overweight) and 10–12.99 years (for adjusted prevalence of overweight). Based on maturity adjustment, the odds of 'at risk of overweight' or obesity for urban female students were, respectively, 1.6 and 4.9 times greater than the odds for rural female students (M-H combined OR = 1.6, $\chi^2 = 4.03$, $P < 0.05$; M-H combined OR = 4.9, $\chi^2 = 10.56$, $P < 0.01$). The odds of overweight or obesity for urban male students were, respectively, 5.7 and 12.1 times greater than the odds for rural male students (M-H combined OR = 5.7, $\chi^2 = 68.75$, $P < 0.01$; M-H combined OR = 12.1, $\chi^2 = 72.58$, $P < 0.01$).

Discussion

Age at menarche and spermarche and maturity adjustment

The median age of menarche and spermarche was delayed for Shaanxi rural female and male students not only in comparison with the NCHS/WHO reference data, but also in comparison with Shaanxi urban female and male students. Similar results showing a difference between urban and rural adolescent populations can be found in previous studies in China and other countries. In 1976 age of menarche in rural Poland was 13.4 years but in Warsaw it was 12.7 years.[13] A previous study in China observed a higher proportion of

Table 3. Unadjusted prevalence (%) of thinness (BMI-for-age < 5th percentile of NCHS/WHO reference) in Shaanxi students aged 10–17.99 years by sex and urban/rural status

Age (years)	Females *n*	Females Thinness (%)	Females 95% CI	Males *n*	Males Thinness (%)	Males 95% CI
Urban						
10–10.99	193	18.13	12.97–24.31	195	15.38	10.63–21.23
11–11.99	194	17.01	12.01–23.05	201	16.92	12.01–22.83
12–12.99	202	20.30	14.98–26.51	195	24.62	18.74–31.28
13–13.99	190	11.58	7.40–17.00	192	19.27	13.95–25.57
14–14.99	204	7.35	4.17–11.84	193	12.44	8.13–17.94
15–15.99	198	4.55	2.10–8.45	199	11.56	7.47–16.84
16–16.99	196	5.10	2.47–9.18	189	12.70	8.31–18.30
17–17.99	198	5.56	2.81–9.72	201	10.95	6.99–16.10
Rural						
10–10.99	191	27.23	21.05–34.12	195	18.97	13.73–25.19
11–11.99	195	20.51	15.08–26.87	201	20.90	15.49–27.18
12–12.99	183	24.04	18.05–30.90	194	26.29	20.24–33.07
13–13.99	209	11.00	7.11–16.05	195	18.46	13.28–24.63
14–14.99	201	3.98	1.73–7.69	198	20.20	14.84–26.48
15–15.99	190	2.63	0.86–6.03	199	12.56	8.30–17.98
16–16.99	189	3.70	1.50–7.48	193	11.92	7.71–17.34
17–17.99	209	2.87	1.06–6.14	202	5.94	3.11–10.15

Table 4. Unadjusted prevalence (%) of 'at risk of overweight' (BMI-for-age ≥ 85th percentile of NCHS/WHO) in Shaanxi students aged 10–17.99 years by sex and urban/rural status

Age (years)	Females *n*	Females Overweight (%)	Females 95% CI	Males *n*	Males Thinness (%)	Males 95% CI
Urban						
10–10.99	193	5.70	2.88–9.97	195	11.28	7.20–16.58
11–11.99	194	3.61	1.46–7.29	201	12.44	8.21–17.81
12–12.99	202	3.47	1.40–7.01	195	9.23	5.56–14.20
13–13.99	190	4.21	1.84–8.13	192	7.81	4.44–12.56
14–14.99	204	1.96	0.54–4.94	193	3.11	1.15–6.64
15–15.99	198	4.55	2.10–8.45	199	4.52	2.09–8.41
16–16.99	196	1.02	0.12–3.64	189	6.88	3.71–11.48
17–17.99	198	1.52	0.31–4.36	201	5.47	2.76–9.58
Rural						
10–10.99	191	0.52	0.01–2.88	195	0.51	0.01–2.82
11–11.99	195	0.51	0.01–2.82	201	1.99	0.54–5.02
12–12.99	183	0.55	0.01–3.01	194	1.55	0.32–4.45
13–13.99	209	0.96	0.12–3.41	195	1.03	0.12–3.66
14–14.99	201	1.99	0.54–5.02	198	1.01	0.12–3.60
15–15.99	190	0.53	0.01–2.90	199	1.01	0.12–3.58
16–16.99	189	2.65	0.87–6.07	193	0.00	0–1.89
17–17.99	209	0.96	0.12–3.41	202	0.99	0.12–3.53

urban males (51%) reporting spermarche at 14–14.9 years than rural males (41%).[16]

Socioeconomic, genetic and climatic factors mainly influence the mean age at menarche and spermarche.[13] In this study, it is unlikely that genetic and climatic factors differed between urban and rural populations of Shaanxi. The level of socioeconomic development may be a key factor accounting for dietary or other environmental differences between urban and rural populations that cause maturational delay. For example, the average yearly consumption for non-farmers was 3.2 times that of farmers (Renminbi 1453/449) in 1991.[17] The conclusion is consistent with Cameron's observation that the poorer the socioeconomic conditions, the later the age of onset of menarche and spermarche.[18]

Changes in anthropometric dimensions are associated with maturational phenomena[11] and given that there is a marked variation in the timing of maturational changes, assessment of growth and nutritional status of adolescents based exclusively on chronological age may be inaccurate or misleading.[11] Therefore, the use of indicators of sexual maturity is mandatory for proper interpretation of anthropometry of adolescents.[11,19]

For female students maturity adjustment was performed based on the median age at menarche but this approach only partially fulfilled the WHO recommendations. The other WHO recommended maturational indicator, breast stage 2 (B2), was not available.[11] The fact that we did not use it in the

Table 5. Unadjusted prevalence (%) of obesity[a] in Shaanxi students aged 10–17.99 years by sex and urban/rural status

Age (years)	Females *n*	Females Obesity (%)	Females 95% CI	Males *n*	Males Obesity (%)	Males 95% CI
Urban						
10–10.99	193	3.63	1.47–7.33	195	9.23	5.56–14.20
11–11.99	194	1.55	0.32–4.45	201	10.45	6.58–15.53
12–12.99	202	1.49	0.31–4.28	195	7.18	3.98–11.75
13–13.99	190	1.58	0.33–4.54	192	3.65	1.48–7.37
14–14.99	204	0.49	0.01–2.70	193	1.55	0.32–4.48
15–15.99	198	1.52	0.31–4.36	199	3.02	1.11–6.45
16–16.99	196	0.51	0.01–2.81	189	6.35	3.32–10.83
17–17.99	198	0.51	0.01–2.78	201	5.47	2.76–9.58
Rural						
10–10.99	191	0.52	0.01–2.88	195	0	*0–1.87
11–11.99	195	0	*0–1.87	201	1.00	0.12–3.55
12–12.99	183	0	0–2.00	194	1.03	0.13–3.67
13–13.99	209	0	0–1.75	195	0	0–1.87
14–14.99	201	0	0–1.82	198	0	0.12–3.60
15–15.99	190	0	0–1.92	199	0	0–0.18
16–16.99	189	0	0–1.93	193	0	0–0.19
17–17.99	209	0	0–1.75	202	0	0–0.18

*One-sided, 97.5% confidence interval.

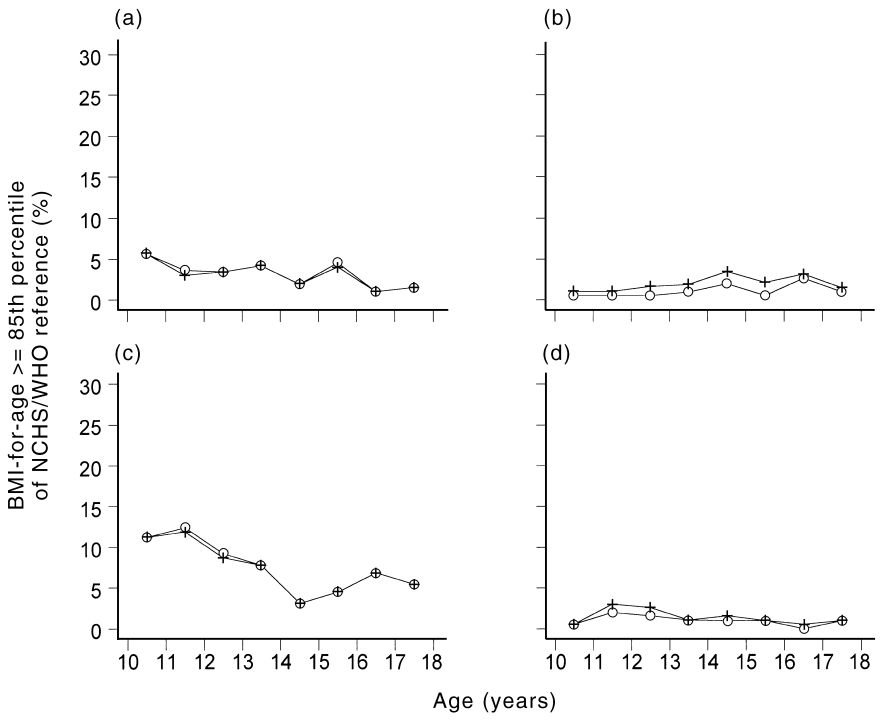

Figure 3. (○) Unadjusted and (+) adjusted prevalence of 'at risk of overweight' in (a) urban female students, (b) rural female students, (c) urban male students and (d) rural male students from Shaanxi, China in 1995. BMI, body mass index; NCHS, National Centre for Health Statistics; WHO, World Health Organization.

adjustment process may have impaired the validity and reliability of the estimates of nutritional status.

However, the main limitation in this study is the method used for maturity adjustment in males. The WHO recommended male maturational indicators, genitalia stage 3 and adult voice, were not measured in the survey. Maturity adjustment was made using the median age at spermarche with reference data from a sample of 150 normal Israeli boys.[15] It should be noted that the maturational reference data and the anthropometric reference data were not from the same source population. The validity of this maturity adjustment method depends on how similar the age of spermarche is between the USA male adolescent growth reference population and the Israeli male adolescent population. Although the maturity adjustment used for males was of uncertain validity, it was considered better to make an adjustment provided the results were interpreted with caution.

Adjusted prevalence was similar to unadjusted prevalence in urban students because the maturational age of the study and reference populations were similar. In comparison the adjusted prevalence was lower than unadjusted prevalence in rural students because the maturational age was greater in Shaanxi students than in the reference populations.

Stunting and thinness

Stunting reflects the process of failure to reach linear growth potential as a result of inadequate nutrition and/or poor health.[11] Genetic and environment factors are considered to contribute to the linear growth of children.[7,11,20,21] A previous study implied that low socioeconomic conditions might mainly account for the differences in height between Chinese school children and children from developed countries.[7] Among the 40 age-sex-area groups in our study, 35 groups had a higher prevalence of stunting that exceeded the normative reference values. This indicates that stunting is still prevalent in Shaanxi which is located in north-west China, one of the most undeveloped areas of the country.

Lin *et al*. also reported that after the age of 16, the ponderal growth of urban girls was slower than that of rural girls.[7] The phenomenon was also observed by Villarejos *et al*. in a study of the growth of Costa Rican children, where the 17–18-year-old rural girls were heavier than their counterparts in cities.[22] A possibility for the difference in thinness is that urban females may be subject to more social pressures than rural adolescents, thus leading them towards dieting for a slim body. The prevalence of thinness in Shaanxi male students was greater than in Shaanxi female students and both were greater than the reference. It appears that the issue of thinness in Shaanxi male students needs more attention.

'At risk of overweight' and obesity

Although 'at risk of overweight' and obesity are defined differently their consequences and determinants should be basically similar. Socioeconomic status is likely to mainly explain the difference in prevalence of 'at risk of overweight' and obesity between Shaanxi students and the reference, and Shaanxi urban and rural students, with these findings being consistent with previous studies.[4,5,7] China has made great economic progress by increasing the gross national product, average income, and personal expenditures through economic reforms in the last 20 years.[6] While the economic improvements may have led to a decrease in the prevalence of stunting and thinness, the prevalence of overweight and obesity may have increased in Shaanxi because of rising wealth and the increasing availability of food. The prevalence of 'at risk of overweight' in urban male students aged 10–11.99 years and of obesity in male students aged 10–12.99 years was higher than in other age groups, which may not be a chance finding. A report from the Centers for Disease Control in the United States indicates that the prevalence of overweight increased from 1976–1980 to 1988–1991 among US children, adolescents and adults.[23] Thus in Shaanxi we might expect that the prevalence of overweight and obesity will increase in all ages and gender groups in the future as economic conditions improve.

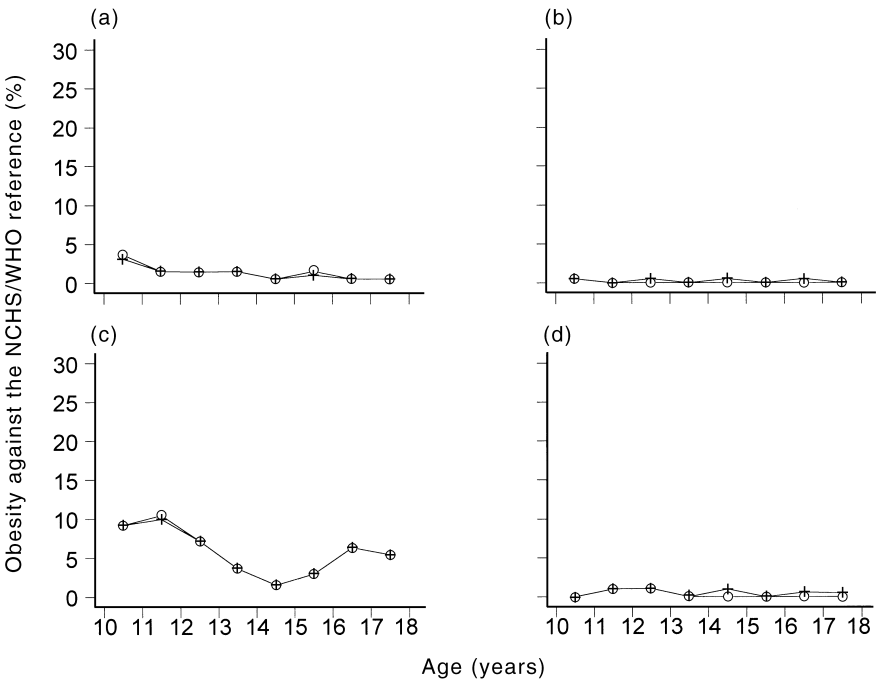

Figure 4. (○) Unadjusted and (+) adjusted prevalence of obesity in (a) urban female students, (b) rural female students, (c) urban male students and (d) rural male students from Shaanxi, China in 1995. NCHS, National Centre for Health Statistics; WHO, World Health Organization.

Conclusions

The median age of menarche and spermarche was delayed for Shaanxi rural female and male students in comparison with reference data. There were no significant differences in median ages of menarche and spermarche between urban female and male students and the reference values. Stunting and thinness were prevalent among almost all age groups of students in Shaanxi. Rural male students were shorter in comparison with urban male students, and urban female students were thinner in comparison with rural female students. Thus, undernutrition in terms of stunting and thinness remains a public health problem in the Shaanxi school population. The prevalence of 'at risk of overweight' and obesity among young urban male students was as high as the reference population. Urban students were more overweight in comparison with rural students.

Poor socioeconomic status of the rural population might be related to the late median age of menarche and spermarche, and the high prevalence of stunting and thinness of Shaanxi rural students. However, the improvement of the economy might also result in the occurrence of overweight and obesity in young Shaanxi urban male students. Therefore a comprehensive intervention including improved nutrition education for a more nutritious diet should be introduced to Shaanxi adolescents. Finally, it is necessary for future surveys to develop national reference data, cut-off points and median ages of attainment of WHO recommended maturational indicators for Chinese adolescents.

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