# Anthropometric Measurements and Weight Status among Elementary Schoolchildren in Lanyu

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**The prevalence of overweight and obesity among children appears to be rising rapidly in Taiwan and many other countries around the world. We examined the anthropometric status of elementary schoolchildren in Lanyu and compared the prevalence of overweight and obesity with school-aged youths according to data from Nutrition and Health Survey in Taiwan, 1993-1996 (NAHSIT). Total 255 schoolchildren (138 boys; 117 girls) aged 7 to 12 years living in Lanyu, an off shore island in Taiwan; were selected for this cross-sectional study. Height and weight were measured and BMI calculated. Overweight, obesity and underweight were based on the recommendation by Department of Health Executive Yuan Taiwan, using age-and gender-specific BMI values set by Chen et al. The overall prevalence of overweight, obesity and underweight were 10.6%, 7.1% and 12.9% respectively. Also the prevalence of overweight, obesity and underweight among girls were 16.2%, 5.1% and 12.8%; among boys were 5.8%, 8.7% and 13.0% respectively. This study provides valuable information on the current anthropometric measurements of Lanyu elementary schoolchildren. New longitudinal studies are needed to estimate the trends of body fat status in Lanyu.**
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**Key words:** anthropometrics, overweight, Lanyu schoolchildren

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## INTRODUCTION

The prevalence of overweight and obesity among children appears to be rising rapidly in many countries around the world[1-3]. Taiwan is unfortunately of no exception[4,5]. Childhood obesity dose not only increases the risk of obesity in adulthood but also the risks of coronary heart disease, hypertension, hyperlipidemia, diabetes, certain cancers (breast, colon, endometrial cancer), and osteoarthritis [6-8]. Psychologically, overweight children face direct negative psychosocial impact that they are more likely to develop undesirable behaviors such as cigarette smoking and alcohol drinking[9-11].

Although there were several studies done to evaluate the overweight state of children and adolescent in Taiwan[4,5], the study populations were Taiwanese Han-people but not other ethnic minorities such aboriginal Taiwanese tribes.

Lanyu, (The Island of Orchids), is a small and mountainous volcanic island 76kms off the southeast coast of Taiwan with a population of 3000. The inhabitants, the Yamis, are the smallest and most primitive aboriginal tribe in Taiwan. There genetic make-up resembles the Malayopoplynesians and is different from Taiwanese Han people. Besides they have their unique culture and lifestyle. No definite study about the body weight state of the school age children had beeen carried out and little was known about their children's anthropometrics. Since different ethnic communities would show different prevalence of overweight and obesity in children[12]. The UK parliament recommended that to tackle obesity in children, it is best to target on the following groups: school age children, those of low socioeconomic states and the ethnic minorities[13]. Therefore in this study, we examined the anthropometric distribution among elementary schoolchildren in Lanyu with a comparison to the prevalence of overweight and obesity in Taiwan. The data of prevalence in overweight in Taiwan was base on the Nutrition and Health Survey in Taiwan, 1993-1996 (NAHSIT).

## MATERIALS AND METHODS

### Study designs and sampling

A cross-sectional study was conducted among all 259 schoolchildren aged 7 to 12 yrs at Lanyu in January, 2005. Only 4 children were excluded because of no accurate measurements available and totally 255 elementary schoolchildren (138 boys; 117 girls) were included. The anthropometric measurements were carried out by well-trained researchers. Individual standing height was measured to the nearest 0.5 cm using a stadiometer and the body weight was measured with a calibrated digital scale to the nearest 0.1 kg. The children were dressed in light clothing and wore no shoes throughout the measurements. Body mass index (BMI) was calculated as body weight in kilogram divided by square of height in meter (kg/$m^2$).

### Definitions of underweight,

**overweight and obesity in children**

In this study the cutoff values of BMI used to determine overweight or obesity were based on the recommendations by the Department of Health Executive Yuan Taiwan. The data was adapted from Chen's study in a nation-wide fitness evaluation for students age from 6-18 in 1997 and developed the age-and-gender-specific BMI from fitness test score for Taiwan children (appendix. 1)[14,15].

**Methods of analysis**

Data was analyzed by using the statistic software SPSS for Windows version 10.0. The distribution (mean, SD) of the measurements on height, weight and BMI were analyzed. The prevalence of overweight, obesity an underweight were calculated in each age group (7-12) and in each gender. The overweight children were further divided into 2 groups: the overweight and the obesity for further comparison. The prevalence of total overweight children in Lanyu was compared with the prevalence of the overweight Taiwan children in their age-matched groups according to the data provided by the NAHSIT (1993-1996). The data were analyzed and assessed statistically using two-tailed z-test with significance set at $p<0.05$.

## RESULTS

Table 1 showed the mean values (standard deviation) for standing height, weight and the BMI for schoolchildren in different age and gender in Lanyu and Taiwan (data provided by NAHSIT).

The overall prevalence of overweight, obesity and underweight were 10.6%, 7.1% and.12.9% respectively. The prevalence of overweight and obesity for the different age groups of Lanyu schoolchildren were presented in Table 2. The prevalence of overweight and obesity among girls were 16.2% and 5.1% respectively; among boys were 5.8% and 8.7% respectively. The

Appendix 1. Body Mass Index Cut-offs for Underweight, Overweight, Obese Children Recommended by Department of Health of Taiwan

| Age | Boys | | | Girls | | |
|---|---|---|---|---|---|---|
| | Underweight (<) | Overweight(≧) | Obesity(≧) | Underweight (<) | Overweight(≧) | Obesity(≧) |
| 7 | 14.7 | 18.6 | 21.2 | 14.4 | 18.0 | 20.3 |
| 8 | 15.0 | 19.3 | 22.0 | 14.6 | 18.8 | 21.0 |
| 9 | 15.2 | 16.7 | 22.5 | 14.9 | 19.3 | 21.6 |
| 10 | 15.4 | 20.3 | 22.9 | 15.2 | 20.1 | 22.3 |
| 11 | 15.8 | 21.0 | 23.5 | 15.8 | 20.9 | 23.1 |
| 12 | 16.4 | 21.5 | 24.2 | 16.4 | 21.6 | 23.9 |

Table 1. Mean Values (SD) for Height, Weight, and BMI among Lanyu and Taiwan Elementary Schoolchildren Stratified by Gender and Age

| | Girls*[Lanyu/Taiwan : 117/722] | | | | | | Boys *[Lanyu/Taiwan : 138/726] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Height(cm) | | Weight(kg) | | BMI(kg/m$^2$) | | Height(cm) | | Weight(kg) | | BMI (kg/m$^2$) | |
| Age | Lanyu | **Taiwan | Lanyu | **Taiwan | Lanyu | **Taiwan | Lanyu | **Taiwan | Lanyu | **Taiwan | Lanyu | **Taiwan |
| 7 | 117.0(5.2) | 122.6(5.9) | 22.2(3.6) | 23.1(4.2) | 16.2(2.0) | 15.2(1.8) | 120.1(4.0) | 123.9(6.5) | 23.3(3.9) | 24.9(4.5) | 16.1(2.0) | 16.1(2.2) |
| 8 | 124.7(6.9) | 129.4(5.6) | 27.9(8.3) | 27.2(6.1) | 17.7(4.0) | 16.1(2.6) | 125.5(4.1) | 129.5(5.2) | 25.8(4.7) | 28.2(6.1) | 16.3(2.8) | 16.7(2.8) |
| 9 | 128.3(6.9) | 135.1(6.6) | 28.9(8.1) | 30.9(7.4) | 17.3(3.2) | 16.8(3.0) | 129.5(4.9) | 134.8(6.6) | 28.3(4.1) | 31.1(6.4) | 16.9(2.8) | 17.0(2.6) |
| 10 | 135.8(6.9) | 142.6(7.2) | 35.2(6.6) | 35.5(8.2) | 18.9(2.3) | 17.3(2.9) | 134.6(4.4) | 140.0(6.4) | 33.2(8.1) | 34.8(7.8) | 18.2(3.5) | 17.6(3.1) |
| 11 | 142.6(7.4) | 148.2(6.3) | 39.6(9.8) | 39.7(8.1) | 19.2(3.1) | 18.0(3.0) | 142.1(5.7) | 145.8(7.1) | 39.3(8.3) | 38.7(8.8) | 19.4(3.3) | 18.1(3.3) |
| 12 | 146.4(6.1) | 138.6(12.5) | 40.2(8.5) | 46.5(10.5) | 18.6(3.0) | 19.5(3.5) | 147.6(8.5) | 151.1(9.2) | 41.8(9.3) | 42.0(9.6) | 19.0(3.1) | 18.3(3.1) |

* Sample size of Lanyu and Taiwan elementary schoolchildren

** Data from Nutrition and Health Survey in Taiwan, 1993-1996

Table2. Prevalence of Overweight and Obesity among Lanyu Elementary Schoolchildren for Both Gender at Different Ages

| | Girls | | | Boys | | | Total | |
|---|---|---|---|---|---|---|---|---|
| Age | No. | Overweight | Obesity | No. | Overweight | Obesity | Overweight | Obesity |
| 7-8 | 41 | 19.5%(8) | 4.9%(2) | 39 | 2.6%(1) | 2.6%(1) | 11.2%(9) | 3.8%(3) |
| 9-10 | 37 | 10.8%(4) | 5.4%(2) | 51 | 5.9%(3) | 11.8%(6) | 8.0%(7) | 9.1%(8) |
| 11-12 | 39 | 17.9%(7) | 5.1%(2) | 48 | 8.3%(4) | 10.4%(5) | 12.6%(11) | 8.0%(7) |
| Total | 117 | 16.2%(19) | 5.1%(6) | 138 | 5.8%(8) | 8.7%(12) | 10.6%(27) | 7.1%(18) |

prevalence of total overweight (including overweight and obesity) between Lanyu children aged 7-9 years and 10-12 years were further investigated separately, which showed that the younger group had lower prevalence of total overweight than the older one (12.7% vs. 21.9% $p$=0.05). There was no difference in the prevalence of total overweight between girls and boys in Lanyu. (21.3% vs. 14.5% $p$=0.19).

The prevalence of total overweight among Lanyu schoolchildren in both genders were not significantly different from that in Taiwan (21.3% vs. 15.1% $p$=0.10 among girls and 14.5% vs. 16.1% $p$=0.70 among boys).

The prevalence of underweight in Lanyu children was 12.8% in girls and 13.0% in boys.

## DISCUSSION

In this study, there was no significant difference in the average weight and BMI between those schoolchildren in Lanyu and Taiwan. However, the average height of Lanyu children was likely shorter than some of their age-matched groups in Taiwan. It maybe argued that our sample population was not large enough to make this conclusion, however this study had investigated almost the entire population of 7-12 year old children living in Lanyu.

The prevalence of total overweight (overweight and obesity) was 21.3% in girls and 14.5% in boys. Genetic difference may partially explain the differences. However genetic difference along failed to explain our results that boys and girls in Lanyu and Taiwan had similar overweight prevalence. Differences in culture and lifestyle should also be considered, especially their diet and sedentary behavior.

It is always difficult to compare the overweight prevalence in different study population. The methodology and definition varies in each study, albeit genetic, environmental, cultural and lifestyle difference. In Australia, the prevalence of obesity and overweight were 19-21% in boys and 21-24% in girls respectively[16]. In Mediterranean countries, the prevalence for overweight children was in the range 20-40%, while those in northern areas the rates was within 10-20%[17].

In Indian children aged 9-15 years, the prevalence of obesity decreased significantly with age, but rose again at the age of 15[18]. In Hong Kong children, boys aged 10-13 years and girls aged 10-12 years showed the largest increased prevalence in overweight [19]. In our study, the prevalence of total overweight of Lanyu children aged 7-9 years was lower than that of children aged 10-12 years. In England, 23% of 5-15 year old children were overweight, and 6% of these were obese. Girls more than boys were overweight (24% vs. 22%, $p$=0.03)[20]. In Taiwan and the Fuchien province of China, boys had a higher prevalence of obesity than girls among those aged 6.5-18.5[21]. In our study, the prevalence of total overweight of Lanyu children aged 7-9 years was lower than that of children aged 10-12 years and we did not observe significant gender differences in the prevalence of overweight

and obesity among Lanyu schoolchildren.

In the aspect of underweight, malnutrition used to be the major nutritional disorder in developing countries. Under-nourished children probably still exist in Lanyu. The prevalence of underweight children in Lanyu children was 12.8% in girls and 13.0% in boys. Wang et al. examined the trends of weight status from 4 countries including Russia, Brazil, China and United States. According to their study, China had the highest (11.5% in girls, 14.4% in boys) and the United States had the lowest underweight prevalence (3% in girls, 3.6% in boys)[1,22]. It is difficult to compare our study results with their reports to determine whether a significant number of Lanyu children are malnourished or not because of different definitions for underweight and age groups.

BMI is a simple to calculate and non-invasive health index and serves as a good screening tool[23]. Several BMI curves for different countries and ethnics have been published during the last decade. Among these studies some suggested that the cut-off values of BMI to define obesity should be adjusted to a lower value in Asian compared to Caucasians[24-26]. Therefore, to find out the adequate cut off values which are specific to Taiwanese and its aboriginal children to evaluate their weight states are essential and necessary.

In conclusion, this cross-sectional study provided valuable information on the current anthropometric measurements of elementary schoolchildren in Lanyu. Further longitudinal studies are needed to estimate the trends in body fat status of Lanyu children.

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# 蘭嶼小學學童體位及肥胖盛行率調查研究

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近年來全世界學童過重和肥胖的盛行率持續上升，台灣也不例外。本研究主要是調查蘭嶼小學學童身高、體重的體位情形及以身體質量指數（BMI）來評估過輕、過重、肥胖學童比例，並且和台灣國民營養健康調查1993-1996結果作比較。我們以行政院衛生署2001年公佈的兒童身體質量指數數據爲標準值，定義BMI≤15百分位爲體重過輕、85百分位≤BMI<95百分位體重過重、BMI≥95百分位爲肥胖。結果顯示255位蘭嶼小學學童（男138；女117）中，10.6%爲體重過重，7.1%爲肥胖，而體重過輕則爲12.9%。以性別區分，蘭嶼女學童16.2%爲體重過重、5.1%爲肥胖、12.8%爲體重過輕；男學童體重過重佔5.8%、肥胖8.7%、體重過輕13.0%。

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