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Associations of physical characteristics with socioeconomic status and lifestyles among migrant peasant workers' children in China

（中国農民工の子供における体格及びそれに関連する社会経済的・生活行動的要因）

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Chapter 1

Introduction

1.1 Background

Rapid urbanization in China has made, it extremely obvious that there is a shortage of labor in southeast coastal cities. Since the economic reform and Opening-Up Policy (1978) in China, the spare labor force has been transferring from rural areas to cities, and the population of laborers has consistently increased. The term “migrant peasant worker” (MPW), refers to those who migrate from rural areas to urban areas seeking employment opportunities. By the end of 2009, the number of MPWs had reached over 145 million[1]. Most MPWs' children accompany their parents to the cities. Moreover, the number of MPWs' children less than 14 years old has been estimated to be 15 million, and about 3.8 million MPWs' children were in Shanghai City in 2005[2].

The Chinese government has classified every Chinese citizen as either “rural register” or “urban register” as a means of categorizing household registration. This system is known as “Hukou”. Newborns have to be registered in the area of parental registration and citizens can only receive government benefits within the district of their household registration. Moreover, changes to the Hukou are restricted because there are significant differences in the benefits received from local governments between rural Hukou and urban Hukou. Citizens registered under the

urban Hukou enjoy access to state subsidies such as food allowance, lifetime employment, medical insurance, housing, social security and pensions. Those registered under the rural Hukou are not entitled to these statesubsidies[3]. MPWs have no access to services from local governments because of their rural Hukou status, and their children are unable to attend state schools in cities. They usually cannot afford expensive private schools, so they are forced to attend schools in very poor conditions. Hence, the MPWs' children are at a higher risk of suffering from poor health than children registered under the urban Hukou. In contrast, since the migration from rural area to urban area has increased the MPWs' family income[1], parents are in a better position to provide for their children. Their increased income enables more MPWs to purchase medical insurance for their children, which ensures adequate medical care. From this aspect, migration has a favorable impact on their children's health[4-6].

1.2 Previous studies on growth of MPWs' children

A few studies have reported the growth status of MPWs' children. Zhang ZS[7] reported that MPWs' children are more likely to be under weight, and have anemia and dental caries than children of citizens in Shanghai City. Yin XJ[8] showed that MPWs' children weighed less than children of citizens in Shanghai City. Li H[9] reported that the growth and development parameters (height, body weight, chest circumference, vital

capacity, body mass index [BMI]) of MPWs' children were much lower than those of urban children. There are many studies on the health problems of immigrant children in other countries. Immigrant children can be divided into international immigrant children and internal migration children. International immigrants are people who move from one country to another country, and internal migrants are those who move from one region to another in the same country. We believe that Chinese MPWs exhibit characteristics similar to those of both international immigrants and internal migrants. On the one hand, MPWs have no "urban Hukou" in cities in the same way international immigrants have no local nationality. On the other hand, Chinese MPWs have migrated from rural areas to urban areas in China. In this way, they are similar to internal migrants: they speak the same language and have a lifestyle similar to that of their urban counterparts. Immigrant children with low socioeconomic status[10, 11] and limited access to health care[12-14] are at higher risk of having poor health than native-born children. Immigrant children have also been identified as having an array of poor health issues, including growth retardation[15, 16], obesity[17-19] and mental health problems[20, 21]. Some studies have shown that internal migrant children were stunted and underweight due to their unhealthy lifestyles[22, 23].

1.3 Relationships between growth and socioeconomic status and lifestyles behaviors in MPWs' children

Yan Z[6] showed that, after adjusting for family income, the curves of four physical indices of height, weight, BMI and chest circumference for either boys or girls were higher for MPWs' children than those for children still living in the rural areas from where the MPWs' children had migrated. This study also reported that the differences in the rates of being overweight in the two groups regardless of age and sex were highly significant, except for female children 7–9 years old. Moreover, comparing children of similar age and sex, the prevalence rates of obesity, dental caries and poor vision in MPWs' children were significantly higher than in rural children.

1.4 Study aims

Previous studies have reported that physical indices of height and weight for MPWs' children were lower than those of urban children. There is only one paper that compares the physiques between MPWs' and rural children, and there is no evidence for association between physiques and socioeconomic factors in MPWs' children. Furthermore, there is no studies that simultaneously compare physiques among MPWs', rural and urban children. The purpose of the present study was to examine associations of physical characteristics with socioeconomic status and lifestyles by comparing rural and urban children among MPWs' children in China.

Chapter 2

Methods

2.1 Study design

A cross-sectional survey of children 7–12 years old was adopted, and the study design was approved by the Ethics Committee of the Graduate School of Health and Sport Sciences at Chukyo University.

2.1.1 Study areas

The study areas were located in Shanghai City and Wuhu City in Anhui Province. This province is the original home to the greatest number of MPWs in Shanghai City[24]. Furthermore, the latitude and temperature in Wuhu City are almost the same as in Shanghai City (average annual temperature: Shanghai City 15.8°C, Wuhu City15.9℃ ; latitude: Shanghai City 31.2° N, Wuhu City 31.3° N). Anhui Province is located in Eastern China, across the basins of the Yangtze River and the Huai River. The capital of the province is Hefei. Wuhu City is located 143 km southeast of Hefei. Wuhu City covers 3317 km^2 and has a total population of approximately 2,307,000 people. The majority of the population lives in rural areas. It is an agricultural district that heavily exports its labor force[25]. Located at the mouth of the Yangtze River Delta in the middle region of the Chinese coast, Shanghai City covers 6340.5 km^2 and has a total population of approximately 23,470,000 people. It is a major financial center and the busiest transportation hub in China[26] (Figure 1).

2.1.2 Study population

The subjects included two urban groups in Shanghai City and one rural group in Anhui Province. Each group consisted of school-age children from two primary schools. Of the two urban groups, one group comprised MPWs' children in two special primary schools founded by MPWs themselves. One of the two schools is located in an urban area and the other one is in a suburb of Shanghai City. The other group comprised children of Shanghai City citizens. These children attend two state primary schools. One is located in an urban area and the other in the suburbs. For the rural group, two state primary schools were selected from rural areas in Wuhu City. One lies in a rural mountain district and the other is in a rural plain district. The original cohort comprised 4,132 subjects, all children from six primary schools. Among them, 964 were not measured due to their absence during the physical measurement session, and 592 did not complete the questionnaires. After physical measurements, 119 were excluded, because 95 were not in the required age range of 7–12, and 24 were from ethnic minority groups (Figure 2). We defined children of rural residents as group1, MPWs' children as group 2 and children of citizens in Shanghai City as group3. Final totals for the analysis included 748 children in group 1, 914 in group 2 and 795 in group 3 (Table 1).

2.2 Body measurements

The physical characteristics measured in this study were height, weight,

sitting height and body fat percentage. These physical indices were chosen because height and weight are used to assess the nutritional health status of a child, sitting height is often used as an indication of body proportion, and body fat percentage is used as an indicator of body composition[27, 28]. AZT-120 Weight-Height-Sitting height meter (Wuxi Weighing Apparatus Company, China) and TBF-310 Body Fat Calculator (TANITA Company, Japan) were used for anthropometric measurements. The boys were measured wearing underpants only, and girls wore a t-shirt and a pair of light trousers. None of the subjects wore shoes. Heights were measured with children's backs against metal column scales, knees not bent, arms at sides, shoulders relaxed and feet flat on the floor, and were recorded to the nearest 0.1cm. Sitting heights were measured with children sitting against the metal column scales, and were recorded to the nearest 0.1cm. Weighing was done on platform scales, and the results were recorded to the nearest 0.1 kg. Body fat percentages were measured while children stood on platform scales after their feet were cleaned withpaper[29]. The anthropometric measurements were performed by graduate students majoring in sport and health sciences who were specially trained for one week.

2.3 Questionnaire investigation

We designed the questionnaire based on the Chinese National Nutrition and Health Survey, and National Health Interview Survey in the USA[30, 31].

A preliminary questionnaire was assessed using a pilot survey in March 2010. According to the pilot survey, the questionnaire was slightly modified for ease of understanding and responding. The questionnaire included questions concerning the occupation of the child's parents, the level of parental education**,** the guardian's cognition of health, the child's living environment and family status, the child's learning and living condition, the child's health status, the child's diet and the child's food intake frequency. We distributed the questionnaire to each school with the principal's consent. The questionnaires were handed out to the children and were collected by the teachers in charge of each class. Each child was asked to complete the questionnaires by consulting with their parent or guardian at home.

2.4 Statistical analyses

2.4.1 Associations between physiques and socioeconomic factors among the three groups

Many studies have explored the associations between socioeconomic factors and children's physiques. Those studies noted that children with low socioeconomic status are at a higher risk of growth retardation or obesity, and that socioeconomic status was a multi-dimensional construct that was most often measured by some combination of income, education and occupation[32-34]. Therefore, in this report, parental occupation, parental education and family monthly income were selected as indices of

socioeconomic status (Table 2).

For analysis of variance (ANOVA) and analysis of covariance (ANCOVA), the socioeconomic factors were reclassified because the questionnaire contained an excessive number of categories for occupation and family monthly income, and there were few parents with graduate degrees. The three socioeconomic factors were reclassified as follows: (i) occupation: administrator, office clerk personnel and military personnel (OCP), professional (PRO), business service (BS), agriculture and water conservancy laborers (AWCL), production of transport equipment operators (PTEO), unemployed (UNE), others (OTH); (ii) education: primary school or lower, junior high school, senior high school, college or higher; (iii) family monthly income (yuan): ≤2000, 2001–5000, 5001≤[35].

The first analyses examined the differences in physiques among the three groups by ANOVA. The dependent variables included height, weight, sitting height and body fat percentage. Secondly, ANCOVA was applied to analyze the associations between children's physiques and socioeconomic factors by taking height, weight, sitting height and body fat percentage as dependent variables, socioeconomic factors (parental occupation, parental education, family monthly income) as independent variables and age as a covariant. Thirdly, ANCOVA was used to assess differences in physiques among the three groups by adjusting for

socioeconomic factors (parental occupation, parental education, family monthly income). The analyses were conducted by taking physiques as a dependent variable, the group and socioeconomic factors as independent variables, and age as a covariant (Figure 3). All statistical analyses were performed using SPSS17.0 for Windows.

2.4.2 Associations between physiques and socioeconomic status and lifestyles in MPWs' children

Yan Z reported that the interaction between children's growth of MPWs and migration is a complex and dynamic one that is influenced by the socioeconomic status and lifestyles[6]. According to Chinese statistical data, the migration from rural area to urban area has increased the MPWs' family income[1]. Their increased income enables more MPWs purchase healthy items to promote their child's growth. From this aspect, migration has a favorable impact on their children's health[4-6]. In this study, associations of physiques with socioeconomic status and lifestyles were examined in MPW's children who lived in Shanghai city.

Firstly, we derived sex- and age- specific physical indices (height, weight, BMI) cut-offs for 7- to 12-year-old MPWs' children with 914 subjects, using the less than 15th percentiles and greater than 85th percentiles to define poor growth ($<P_{15}$) and good growth ($P_{85}<$), respectively, and others to define normal growth (P_{15}–P_{85}). Secondly, the chi-square test was used to examine the differences in the proportion of

socioeconomic and lifestyle behavior factors among the categorized indices (height, weight, BMI). Finally, simple logistic regression analyses were applied to analyze socioeconomic and lifestyle behaviors factors associated with growth status among MPWs' children.

In this study, the duration of living in Shanghai City <60 months, monthly income <2000 yuan, parental occupation (unemployment), parental education (primary school or lower), house size ≤30m^2 and child without his own bedroom were selected as indices of socioeconomic status. Method of getting to school on foot, duration of physical activity ≤30 min/day, watching TV, playing video games or using computers≥ 3h/day, and being a picky eater were selected as indices of the lifestyle behavior factor.

Chapter 3

Results

3.1 General characteristics of subjects

Table 2 presents the frequencies and proportions for parental occupation, parental education and family monthly income.

For parental occupation, a high proportion of parents of children in group 1 were AWCL, with 31% for fathers and 38% for mothers. In group 2, 56% of fathers were PTEO and 47% of mothers were UNE. In group 3, there was a high percentage of PTEO, with 23% for fathers. Twenty-nine percent of mothers in group 3 were employed in BS.

Regarding parental education, more than half of the fathers and mothers in group1 had a primary school education level or lower (51% for fathers, 52% for mothers). A high proportion of those in group 2 had a primary school education level or lower (45% for fathers, 42% for mothers). A high proportion of those in group 3 had an education level of senior high school (39% for fathers) or junior high school (35% for mothers). The education level was high in ascending order of group 1, group 2 and group 3 for both fathers and mothers. The father's education level was higher than the mother's level in all groups.

Family monthly income was high in ascending order of group 1, group 2 and group 3. Among the three groups, family monthly income (yuan) ranged from 1001 to 2000 for a high proportion in group 1 (26%) and in group 2 (22%), and ranged from 5001 to 6000 for 14% in group 3.

3.2 Comparisons of physiques among rural children, MPWs' children and urban children

Comparisons of physiques among the three groups are presented in Figure 4. There were significant differences in all physical indices, regardless of sex (p <0.001). For boys and girls, both height and sitting height were lower for MPWs' children than for urban children, except for 7-year-old boys and 12-year-old girls. MPWs' children weighed less than urban children, and had a lower body fat percentage than urban children, except for 7-year-old boys and 7- to 9-year-old girls. For all age groups, regardless of sex, MPWs' children had bigger physiques than rural children.

3.3 Relationships between physiques and socioeconomic factors

Tables 3 and 4 show associations of physiques with parental occupation. For both boys and girls, all indices displayed statistically significant associations with parental occupations (p <0.001). Among the fathers' occupations, both boys and girls whose fathers were AWCL and UNE had relatively small physiques, and those whose fathers were OCP, PRO and PTEO had big physiques. For the mothers' occupations, boys whose mothers were AWCL had relatively small physiques. Similarly, girls whose mothers were AWCL had relatively small physiques, while those whose mothers were OCP, PRO, BS and PTEO had big physiques.

There were strong associations between parental education and all

physical indices (Table 5, p <0.001). Boys and girls whose fathers had higher education levels were bigger than those whose fathers had lower education level. The results with regard to mothers' education level were similar.

Family monthly income was significantly associated with children's physiques (p <0.001). For both sexes, a higher family monthly income was associated with bigger physiques of children in all indices (Table 6).

3.4 Comparisons of physiques adjusted by socioeconomic factors among rural children, MPWs' children and urban children

ANCOVA was performed taking socioeconomic factors and group as independent variables when age was taken as a covariate. There were strong associations between physiques and group in all indices for both boys and girls (p <0.001), but physiques hardly had any associations with socioeconomic factors (Tables 7 and 8). After adjusting for socioeconomic factors, the sizes of physiques were big in descending order of group 3, group 2 and group 1.

3.5 Relationships between physiques and socioeconomic status and lifestyles in MPWs' children

Table 9 presents the frequencies and proportions for socioeconomic status and lifestyle behavior factors among the three categories (<P_{15}, P_{15}–P_{85} and P_{85}<) by height, weight and BMI. Reference categories were P_{15}–P_{85}. For the socioeconomic factors, in categories (<P_{15}) for both

height and weight, there were high proportions of duration of living in Shanghai City <60 months and child without his own bedroom (p <0.05). Furthermore, more children with their family monthly income (yuan) ≤2000 and house size ≤30m^2 were in category (<P_{15}) for height compared to other categories (p <0.05). Significant associations were found for both fathers with UNE and education level in category (<P_{15}) for BMI. For the lifestyle behavior factors, a significant difference was observed in children with picky eating in category for weight (P_{85}<).

Table 10 shows the odds ratios (ORs) from the single-element logistic regression analysis for both socioeconomic and lifestyle behavior factors among the three categories in height, weight and BMI. Compared with class P_{15}–P_{85}, the family monthly income (yuan) in categories (<P_{15}) for height was more likely to be ≤2000 (OR = 1.55, 95%CI: 1.04 – 2.3), and children in categories (<P_{15}) for weight were more likely to have fathers with UNE (OR = 2.05, 95%CI: 1.22 – 3.46). Children in categories (<P_{15}) for BMI were more likely to have parents with a primary school education level or lower (father: OR = 3.57, 95%CI: 1.20 – 10.60, mother: OR = 3.02, 95%CI: 1.05 – 8.67).

Children in categories (P_{85}<) for height were more likely to have mothers with UNE (OR = 1.92, 95%CI: 1.12 – 3.31), and were less likely to be watching TV, playing video games or using computers ≥3h/day (OR = 0.64, 95%CI: 0.43 – 0.97).

Children in categories (P_{85}<) for weight were less likely to have lived in Shanghai City <60 months (OR = 0.62, 95%CI: 0.43 – 0.90) or not have their own bedroom (OR = 0.57, 95%CI: 0.35 – 0.94). Children in categories (P_{85}<) for weight were more likely to have mother with UNE (OR = 2.72, 95%CI: 1.51 – 4.88), and children in categories (P_{85}<) for BMI were less likely to have father with UNE (OR = 0.48, 95%CI: 0.24 – 0.97).

3.6 Results summary

The height and sitting height of boys and girls of MPWs were lower than those of urban children, except for 7-year-old boys and 12-year-old girls. MPWs' children also weighed less than urban children, and, except for 7-year-old boys and 7- to 9-year-old girls, had a lower body fat percentage. For all age groups, regardless of sex, MPWs' children had bigger physiques than rural children. Among the fathers' occupations, both boys and girls whose fathers were agriculture and water conservancy laborers and unemployed had relatively small physiques, and those whose fathers were office clerk personnel, professional and production of transport equipment operators had big physiques. For the mothers' occupations, boys whose mothers were agriculture and water conservancy laborers had relatively small physiques. Similarly, girls whose mothers were agriculture and water conservancy laborers had relatively small physiques, while those whose mothers were office clerk personnel,

professional, business service and production of transport equipment operators had big physiques. Conversely, children whose parents had a higher education level had relatively big physiques. The children of families with higher monthly income have bigger physiques in all indices. Whereas, when both socioeconomic factors and group were taken as independent variables, for both sexes, there were strong associations between physiques and group in all indices, and there were hardly any associations between physiques and socioeconomic factors.

Simple logistic regression analyses were applied to analyze socioeconomic and lifestyle behavior factors associated with growth status among MPWs' children. Children with a smaller physique were more likely to be from families with lower monthly income and lower parental education, and have fathers that were unemployed. Conversely, subjects with a bigger physique were more likely to have mothers that were unemployed, and were less likely to have lived in Shanghai City <60 months, watch TV, play video games or use computers≥ 3h/day, not have their own bedroom, be a picky eaters and have an unemployed father. Socioeconomic status and lifestyle behaviors in Shanghai City may associate with both poor and good growth status in MPWs' children.

Chapter 4

Discussion

This study found significant differences in physiques among three groups of children. MPWs' children had smaller physiques than children of citizens living in Shanghai City, and MPWs' children had bigger physiques than those of rural children. The former finding is consistent with previous studies that reported MPWs' children were smaller than urban children[7-9]. The latter finding is also consistent with the results from a previous study[6]. We also found that there were strong associations between physiques and each socioeconomic factor such as family income, parental occupation and parental education. These findings were consistent with studies showing that children from families with high socioeconomic status have bigger physiques than those from families with low socioeconomic status[36-40, 42-49]. ANCOVA, in which both socioeconomic factors and groups were taken as independent variables and age was taken as a covariate, revealed strong associations between physiques and group, although there were hardly any associations between socioeconomic factors and physiques. We found MPWs' children with poor growth status were more likely to be from families with a monthly income (yuan) ≤2000, to have fathers with UNE and to have parents with a primary school education level or lower. While children with good growth status were less likely to have lived in Shanghai City <60 months, have fathers with UNE, not have their own

bedroom, watch TV, play video games or use computers ≥3h/day, and be picky eaters. Children with good growth status were more likely to have mothers with UNE.

Firstly, taking socioeconomic factors into account, we explain why MPWs' children had smaller physiques than children of citizens living in Shanghai City, but bigger physiques than rural children. In this study, we examined parental occupation, parental education level and family monthly income as the socioeconomic factors.

Children whose parents worked as agriculture or water conservancy laborers had relatively small physiques. In contrast, children with parents who worked as office clerk personnel and professionals had big physiques. Kuh DL et al reported that children (7, 10 and 11 years old) whose fathers' occupations involved non-manual labor were taller than those whose fathers were manual laborers[40]. The work of agriculture and water conservancy laborers is considered to be manual labor, and that of office clerk personnel and professionals is considered to be non-manual labor according to the Registrar General's categories in the UK[40, 41]. Our findings are generally consistent with that report. Parents with occupations involving non-manual labor can provide their children an array of services, and goods such as proper clothing, housing and food, which are beneficial to children, because non-manual work have higher wages than manual work. Many children of parents with occupations

involving manual labor lack access to those same resources and benefits, thus putting them at risk for being underweight[42, 43]. In our data, occupations such as office clerk personnel and professional are regarded as occupations involving non-manual labor, and they had a tendency to offer a high wage. For parental occupation, there was a higher proportion of these occupations in group 3 than groups 1 and 2. Moreover, for fathers' occupation, although a higher proportion of fathers of children in group 2 have occupations involving manual labor, as in group1, the wages of production of transport equipment operators is higher than that of agriculture and water conservancy laborers[1].

With respect to education, the education level of a parent has a definite association with children's physiques; that is, children in families with higher parental education level have a tendency towards bigger physiques. Many studies have shown that parental education has a profound influence on a child's physical growth[44-49]. Children whose parents have a high level of education have bigger physiques than those whose parents have a low level of education[47-49]. Parents with a high level of education have resources to promote the health of their children, and are in a better position to prevent or reduce disease. Moreover, parents with a high level of education may also have a higher standard of living and healthier behaviors, which directly influence their children. Maternal education is shown to have a strong association with childcare and thus impacts a

child's development[51, 52]. Wang F et al reported that there were strong associations between fathers' education and child development in China[53]. In the present study, the education level was high in ascending order of group 1, group 2 and group 3 for both fathers and mothers, and children's physiques correlated with their parent's education level. This finding is consistent with previous studies[47-50].

As for family monthly income, the associations between socioeconomic status and children's physiques have often been explained in terms of family income[54]. In our study, children from high-income families had bigger physiques than those from low-income families (Table 5). These results are consistent with previous studies[55-57]. How family income affects children's physiques is explained as follows: Family income influences the ability to purchase healthy items that affect a child's growth. A poor family is much more likely to buy a large amount of cheap, unhealthy food to feed their family, rather than a small amount of nutritious food that will leave them hungry. This inadequate dietary habit stunts a child's growth[58, 59]. Furthermore, many poor families cannot purchase necessary health care services[60, 61]. Family monthly income was high in ascending order of group 1, group 2 and group 3. Therefore, similar mechanisms from previous reports are assumed to be at work in the research populations of the present study.

In the present study, we found that although there were strong

associations between physiques and group, there were hardly any associations between socioeconomic factors and physiques by the ANCOVA, in which both socioeconomic factors and groups were taken as independent variables and age was taken as a covariate. The education level was high in ascending order of group 1, group 2 and group 3 for both fathers and mothers. Family monthly income was high in ascending order of group 1, group 2 and group 3. Moreover, the occupations with high wages were high in ascending order of group 1, group 2 and group 3. In contrast, the occupations with low wages were low in descending order of group 1, group 2 and group 3. These results mean that the factor of group has the same tendency as the three socioeconomic factors. This is the main reason why there were strong associations between physiques and group, but there are hardly any associations between physiques and socioeconomic factors in the ANCOVA.

Are there more important factors than socioeconomic factors associated with physiques?

In addition to the socioeconomic factors, there are some other differences among the three groups, such as residential area and household registration, or Hukou. While children in group1 live in a rural area, those in groups 2 and 3 live in an urban area. Many studies have shown that there are differences in physiques between those living in rural and urban areas in China[39, 62-64]. Yin XJ compared the physiques of

university students between those with rural and urban origins[56]. The study showed that college students whose birthplaces were in urban areas were taller and heavier than those whose birthplaces were in rural areas. The urban-origin students were still bigger than rural-origin students after adjusting for gross family income, family income per capita, latitude, air temperature, precipitation and altitude. This means that there are some different factors affecting physiques between rural and urban life during childhood apart from family income, environmental factors and other factors such as disability. Although the subjects in that study were university students, the results are consistent with our findings that children in group 3 had bigger physiques than those in groups 1 and 2 after adjusting for family income. However, no previous reports show a difference in physiques between rural-origin children and urban-origin children after adjusting for parental education or occupation.

In addition to the difference in physiques between the rural-origin and urban-origin groups, another important aspect of the results is that children in group 2 were bigger than those in group 1 and smaller than those in group 3. Yang Z has shown that MPWs' children have bigger physiques than rural children[6]. Zhang ZS reported that MPWs' children are more likely to be underweight, anemic and more likely to lack access to adequate dental care than children of citizens in Shanghai City[7]. Yin XJ showed that MPWs' children weigh less than children of citizens in

Shanghai City[8]. Li H reported that most MPWs' children had much lower growth and development parameters than urban children[9]. Although children in groups 2 and 3 live in urban areas, household registration (Hukou) differs between the two groups. Children in group 2 are entitled to none of the subsidies from local governments, because they do not have an urban household registration[3]. Besides the issue of registration, developmental history was considered to be different, and lifestyle in Shanghai City was also likely different[53, 54]. These factors are thought to be linked to the differences in physiques between the groups.

How should we substantively examine the differences in physiques between groups 1 and 2? It is clear that the migration must have effectively raised the family income of group 2. In fact, the family income of group 2 was higher than that of group 1. However, the story is somewhat complicated, because the parental education level in group 2 was higher than that in group 1. Therefore, group 2 likely had more income than group 1 prior to migrating. Moreover, the differences in physiques are statistically significant even after adjusting for income. Taking these factors into consideration, the differences between groups 1 and 2 were probably caused by both the migration and original differences between them, which could not be adjusted by the three socioeconomic factors.

Secondly, we derived sex- and age- specific physical indices (height,

weight, BMI) cut-offs for 7- to 12-year-old with 914 subjects in MPWs' children, using the less than 15th percentiles and greater than 85th percentiles to define poor growth ($<P_{15}$) and good growth ($P_{85}<$), respectively, and others to define normal growth (P_{15}–P_{85}). Simple logistic regression analyses were applied to analyze socioeconomic and lifestyle behavior factors associated with growth status among MPWs' children. Children with poor growth status were more likely to have a family monthly income (yuan) ≤2000, to have fathers with UNE, and to have parents with a primary school education level or lower. Many studies have indicated associations between family income and parental occupation and education in China, parents with occupations involving non-manual labor or with higher education level have a higher family income than others[65-67]. In our data, the family monthly income was high in ascending order of parental education level. Inversely, families with higher monthly income tended to have a higher proportion of unemployed mothers. Therefore, we suggested that the main factor influencing the children's growth status was family monthly income. Several studies have shown an association between a child's growth and family income[68-70]. Family income influences the ability to purchase healthy food, which affects a child's growth. A poor family is much more likely to have poor dietary habits, which can stunt a child's growth[71, 72]. Furthermore, many poor families cannot afford necessary health care services[73, 74].

We then illustrated the relationship between good growth status and socioeconomic and lifestyle behavior factors. Children with good growth status were less likely to have lived in Shanghai City <60 months, have fathers with UNE, not have their own bedroom, watch TV, play video games or use computers≥ 3h/day, and be picky eaters, but were more likely to have mothers with UNE. We subsequently discussed the association between the growth status of MPWs' children and the duration of living in Shanghai City. Many studies have shown that immigrants are likely to have an earlier onset of puberty, improved physical status and a lower prevalence of stunting than those children who are living place where immigrants lived[10, 75]. Since the migration from rural area to urban area has increased MPWs' family income[5], migration has a favorable impact on their children's health[76, 77]. They are in a better position to provide for their children. Their increased income enables more MPWs to purchase medical insurance for their children, which ensures adequate medical care. From this aspect, living in Shanghai City <60 months was a risk factor for poor growth status among MPWs' children. Concerning the other lifestyle behavior factors, children were less likely to watch TV, play video games or use computers≥ 3h/day, or be picky eaters. A substantial amount of evidence exists regarding the link between the amount of time spent watching TV, playing video games or using computers and growth retardation, likely because children who

spend a lot of time watching TV, playing video games or using computers do not get sufficient exercise[78-80]. Physical activity is beneficial to the growth of human bones and muscles. It strengthens the heart and lungs, and improves the circulatory, respiratory and digestive systems, which is conducive to the growth and development of the human body, and improves disease resistance[81-82]. This study indicated that the growth status of MPWs' children was associated with watching TV, playing video games or using computers≥ 3h/day, confirming the earlier findings[83, 84]. With regard to picky eating, picky eaters consume fewer total fats, less calories and less protein than non-picky eaters. Picky eaters were more likely to selectively eat fruit and vegetables or meat, and an unbalance in food intake was cause for concern given that diets were associated with a decreased risk of being underweight[85, 86].

Finally, several limitations of this study should be noted. First, we could not select subjects from every province where Shanghai City's MPWs originated. We selected Anhui Province as the study area because the largest number of MPWs in Shanghai City were from this province. This might have caused some selection bias in the results. Strictly speaking, the results might reflect the characteristics of Anhui Province and surrounding areas. Second, although the questionnaires were modified to make them easier to understand after a pre-survey, a few respondents (parents or guardians) did not accurately fill out some parts

of the questionnaire. For example, some respondents did not clearly understand the classification for parental occupation, so they were not able to distinguish their particular occupation. This results in more error when comparing children's physiques by parental occupation in group 2 than in other groups. Third, there might have been some errors in the physical measurements. For instance, even though children were instructed to urinate and defecate before the physical measurements, some children probably did not follow the guidelines set forth in the session prior to taking their physical measurement. Fourth, this was a cross-sectional study. It is possible that children in group 2 had bigger physiques than those in group1 before they came to Shanghai City from their rural area. It is difficult to infer causation for the associations of children's physiques with the group.

Despite these limitations, the present study is the first to simultaneously compare the physiques of MPWs' children with those of rural children and urban children. In addition, we have identified associations between physiques related with socioeconomic and lifestyle behavior factors, which bears importance in health education and health promotion programs for growth and development of MPWs' children in urban areas.

Chapter 5

Conclusion

The findings of the present study areas follow:

1. MPWs' children had smaller physiques than children of citizens in Shanghai City, and bigger physiques than children of rural residents. There are strong associations between physiques and socioeconomic factors. Among the fathers' occupations, both boys and girls whose fathers were agriculture and water conservancy laborers and unemployed had relatively small physiques, and those whose fathers were office clerk personnel, professional and production of transport equipment operators had big physiques. For the mothers' occupations, boys whose mothers were agriculture and water conservancy laborers had relatively small physiques. Similarly, girls whose mothers were agriculture and water conservancy laborers had relatively small physiques, while those whose mothers were office clerk personnel, professional, business service and production of transport equipment operators had big physiques. Conversely, children whose parents had a higher education had relatively big physiques. Children of families with higher monthly income had bigger physiques in all indices. Whereas, when both socioeconomic factors and group were taken as independent variables, for both sexes, there were strong associations between physique and group in all indices, and there were hardly any associations between physiques and socioeconomic factors.

2. Among MPWs' children, subjects with smaller physiques were more likely to be from families with a lower monthly income, have an unemployed father and have parents with lower education level. Conversely, subjects with a bigger physiques were more likely to have an unemployed mothers, and were less likely to have lived in Shanghai City <60 months, watch TV, play video games or use computers≥3h/day, not have their own bedroom, be picky eaters and have an unemployed father. Socioeconomic status and lifestyle behaviors in Shanghai City may be associated with both poor and good growth status in MPWs' children.

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Tables and figures

China Anhui Province

Figure 1. Location of the two areas in China where the study was conducted

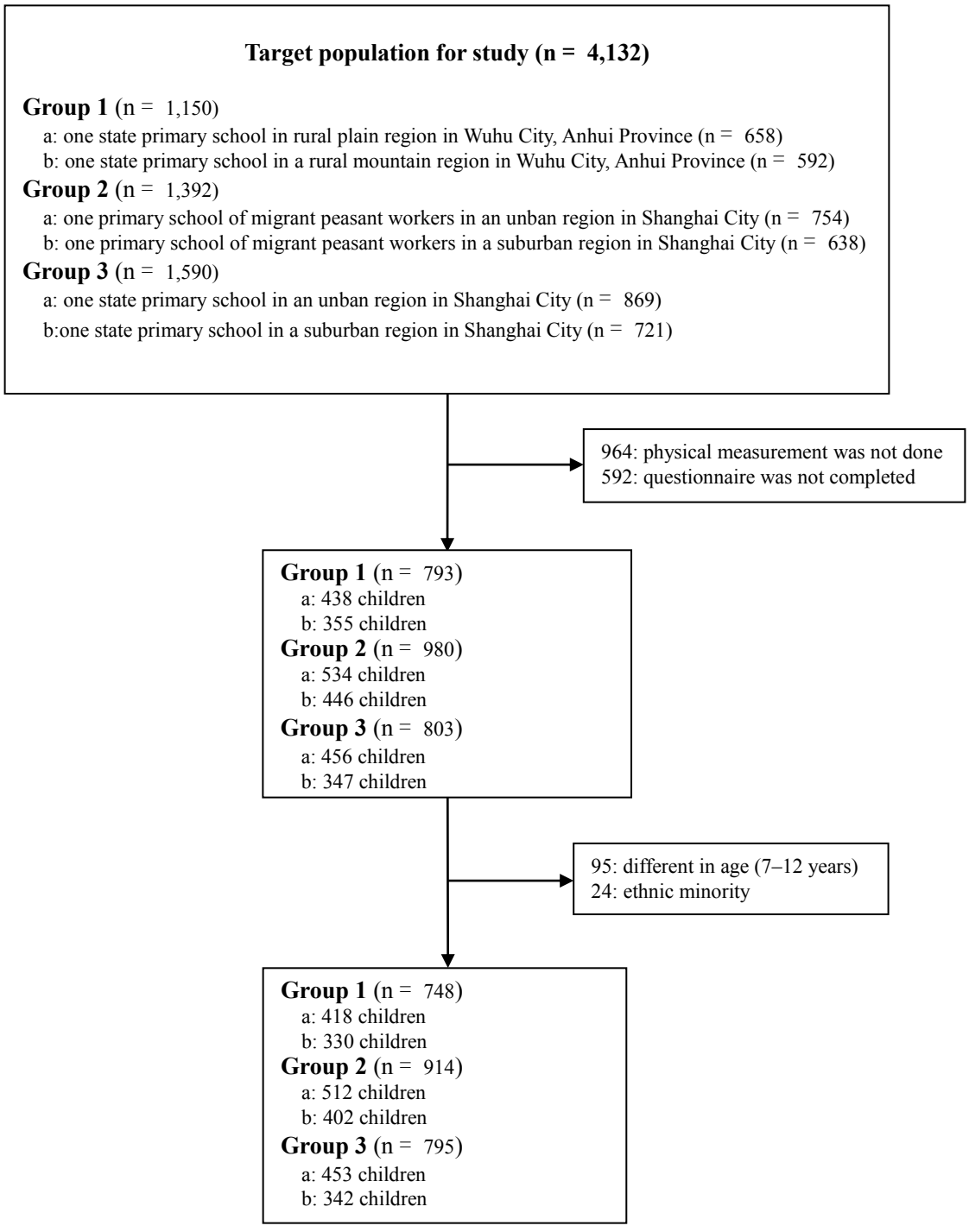

Figure 2. Target populations examined

Table 1. Baseline characteristics of the study population

	Rural residents n = 748 (%)	**Migrant peasant workers** n = 914 (%)	**Citizens in Shanghai City** n = 795 (%)
Sex			
Male	438 (58.6)	557 (60.9)	403 (50.7)
Female	310 (41.4)	357 (39.1)	392 (49.3)
Age (years)			
7	74 (9.9)	107 (11.7)	100 (12.6)
8	97 (13.0)	182 (19.9)	115 (14.5)
9	120 (16.0)	204 (22.3)	167 (21.0)
10	152 (20.3)	162 (17.7)	206 (25.9)
11	174 (23.3)	175 (19.2)	149 (18.7)
12	131 (17.5)	82 (9.0)	58 (7.30)

Table 2. Socioeconomic situations of the study subjects

	Rural residents	Migrant peasant workers	Citizens in Shanghai City
Father's occupation	n = 714 (%)	n = 875 (%)	n = 765 (%)
Administrator	22 (2.9)	7 (0.8)	60 (7.6)
Professional	43 (5.8)	35 (3.8)	=166 (20.9)
Office clerk personnel	35 (4.7)	23 (2.5)	62 (7.8)
Business service	113 (15.1)	172 (18.8)	159 (20.0)
Agriculture and water conservancy laborer	232 (31.0)	15 (1.6)	16 (2.0)
Production of transport equipment operator	86 (11.5)	509 (55.7)	186 (23.4)
Military personnel	8 (1.1)	0 (0)	1 (0.1)
Unemployed	40 (5.4)	22 (2.4)	22 (2.8)
Other	135 (18.1)	92 (10.1)	93 (11.7)
Unknown	34 (4.6)	39 (4.3)	30 (3.8)
Mother's occupation	n = 713 (%)	n = 882 (%)	n = 770 (%)
Administrator	12 (1.6)	3 (0.8)	33 (4.2)
Professional	35 (4.7)	18 (2.0)	92 (11.6)
Office clerk personnel	24 (3.2)	16 (1.8)	121 (15.2)
Business service	106 (14.2)	193 (21.1)	227 (28.6)
Agriculture and water conservancy laborer	284 (38.0)	15 (1.6)	20 (2.5)
Production of transport equipment operator	56 (7.5)	85 (9.3)	116 (14.6)
Military personnel	1 (0.1)	1 (0.1)	0 (0)
Unemployed	84 (11.2)	428 (46.8)	63 (7.9)
Other'	111 (14.8)	123 (13.5)	98 (12.3)
Unknown	35 (4.7)	32 (3.5)	25 (3.1)
Father's education level	n = 714 (%)	n = 873 (%)	n = 765 (%)
Primary school or lower	248 (33.2)	194 (21.2)	16 (2.0)
Junior high school	382 (51.1)	414 (45.3)	188 (23.7)
Senior high school	65 (8.7)	189 (20.7)	313 (39.4)
College	18 (2.4)	74 (8.1)	224 (28.2)
Graduate	1 (0.1)	2 (0.2)	24 (3.0)
Unknown	34 (4.6)	41 (4.5)	30 (3.8)
Mother's education level	n = 718 (%)	n = 886 (%)	n = 771 (%)
Primary school or lower	391 (52.3)	387 (42.3)	54 (6.8)
Junior high school	262 (35.0)	307 (33.6)	279 (35.1)
Senior high school	50 (6.7)	130 (6.3)	229 (28.8)
College	9 (1.2)	58 (6.4)	200 (25.2)
Graduate	2 (0.3)	4 (0.4)	9 (1.1)
Unknown	34 (4.6)	28 (3.1)	24 (3.0)
Monthly income, (yuan)	n = 575 (%)	n = 835 (%)	n = 749 (%)
≤ 1000	173 (23.1)	66 (7.2)	12 (1.5)
1001–2000	194 (25.9)	202 (22.1)	73 (9.2)
2001–3000	114 (15.2)	153 (16.7)	85 (10.7)
3001–4000	32 (4.3)	101 (11.1)	85 (10.7)
4001–5000	21 (2.8)	96 (10.5)	86 (10.8)
5001–6000	14 (1.9)	55 (6.0)	114 (14.3)
6001–7000	8 (1.1)	47 (5.1)	66 (8.3)
7001–8000	5 (0.7)	21 (2.3)	65 (8.2)
8001–10000	5 (0.7)	49 (5.4)	88 (11.1)
10000<	9 (1.2)	45 (4.9)	75 (9.4)
Unknown	173 (23.1)	79 (8.6)	46 (5.8)

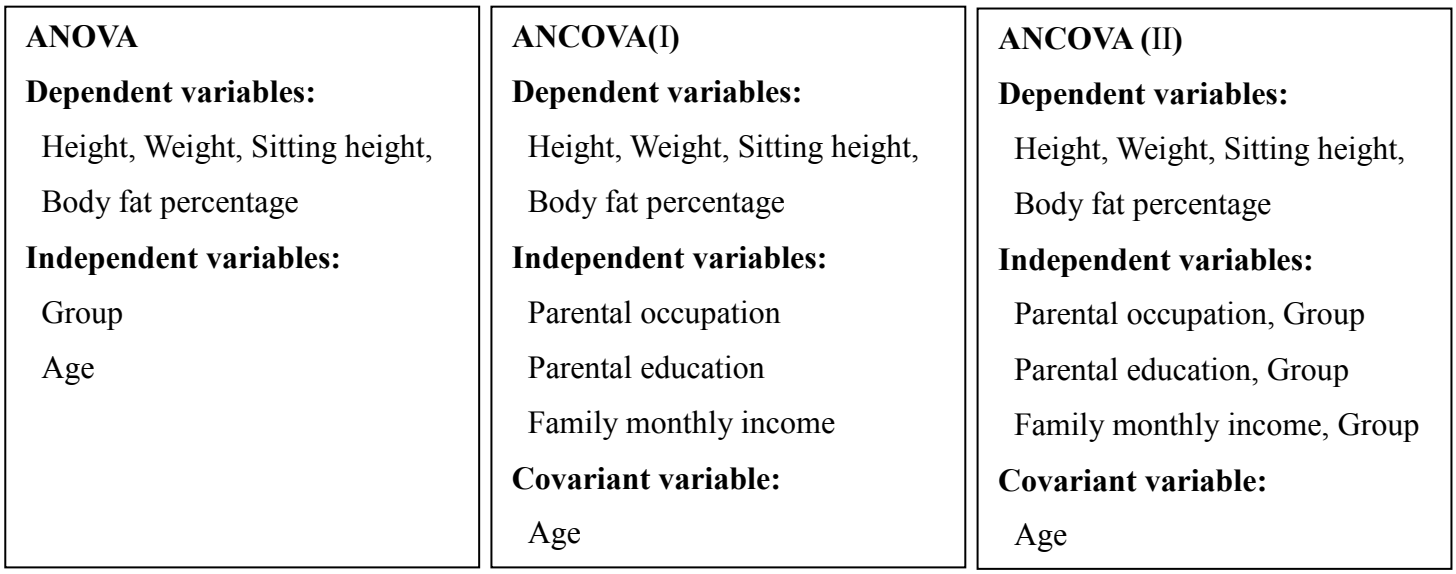

Figure 3. Conceptual frameworks for statistical analyses

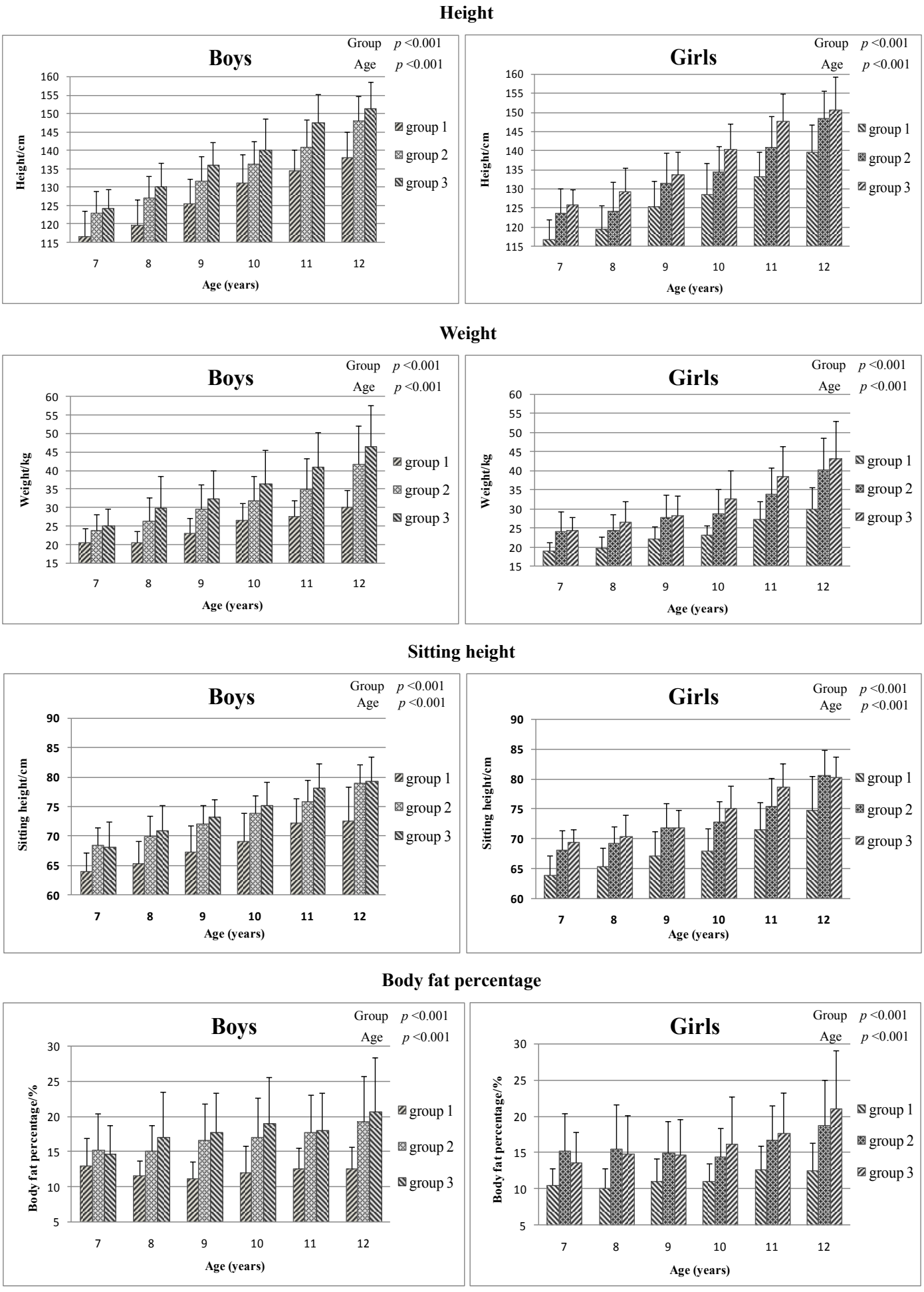

Figure 4. Comparisons of height, weight, sitting height and body fat percentage among the three groups using ANOVA

Table 3. Relationships between physiques and fathers' occupation in the study subjects by using ANCOVA

	Height			Weight			Sitting height			Body fat percentage		
	Beta (95%CI)	**F**	*p*	**Beta (95%CI)**	**F**	*p*	**Beta (95%CI)**	**F**	*p*	**Beta (95%CI)**	**F**	*p*
Boys												
Occupation[a]		15.17	<0.001		14.32	<0.001		17.04	<0.001		16.64	<0.001
OCP	0.85 (-1.00 ─ 2.70)			1.79 (-0.09 ─ 3.66)			-0.34 (-1.40 ─ 0.71)			0.68 (-0.59 ─ 1.96)		
PRO	1.92 (0.13 ─ 3.72)			0.92 (-0.90 ─ 2.74)			0.25 (-0.77 ─ 1.28)			2.10 (0.86 ─ 3.33)		
BS	0.12 (-1.40 ─ 2.70)			-0.02 (-1.56 ─ 1.53)			0.21 (-0.66 ─ 1.08)			0.58 (-0.47 ─ 1.63)		
AWCL	-5.05 (-6.76 ─ -3.34)			-4.51 (-6.25 ─ -2.78)			-2.93 (-3.90 ─ -1.95)			-2.60 (-3.78 ─ -1.42)		
PTEO	1.39 (0.01 ─ 2.78)			1.91 (0.50 ─ 3.32)			1.08 (0.29 ─ 1.87)			2.00 (1.04 ─ 2.95)		
UNE	-1.63 (-4.10 ─ 0.84)			-1.89 (-4.40 ─ 0.61)			-1.56 (-2.97 ─ -0.16)			-0.50 (-2.20 ─ 1.19)		
OTH[b]	─			─			─			─		
Age (years)	4.58 (4.31 ─ 4.86)	1063.42	<0.001	2.77 (2.49 ─ 3.05)	377.18	<0.001	1.87 (1.72 ─ 2.03)	546.59	<0.001	0.46 (0.27 ─ 0.65)	22.96	<0.001
Girls												
Occupation		15.58	<0.001		14.59	<0.001		15.02	<0.001		11.97	<0.001
OCP	3.08 (1.09 ─ 5.07)			2.10 (0.45 ─ 3.76)			0.96 (-0.14 ─ 2.05)			0.62 (-0.68 — 1.91)		
PRO	4.58 (2.65 ─ 6.51)			2.11 (0.51 ─ 3.72)			1.59 (0.53 ─ 2.65)			0.41 (-0.85 — 1.67)		
BS	1.71 (0.01 — 3.41)			1.69 (0.27 ─ 3.1)			1.01 (0.07 ─ 1.95)			0.48 (-0.63 — 1.59)		
AWCL	-3.72 (-5.69 ─ -1.75)			-3.21 (-4.85 ─ -1.57)			-2.43 (-3.52 ─ -1.35)			-2.92 (-4.21 — -1.64)		
PTEO	3.14 (1.61 ─ 4.67)			2.95 (1.68 ─ 4.22)			1.88 (1.04 ─ 2.72)			1.73 (0.73 — 2.73)		
UNE	-1.79 (-4.73 ─ 1.14)			-1.54 (-3.98 ─ 0.90)			-0.09 (-1.71 ─ 1.52)			-1.46 (-3.38 — 0.45)		
OTH	─			—			—			—		
Age (years)	4.62 (4.29 ─ 4.95)	765.69	<0.001	2.68 (2.40 ─ 2.95)	371.25	<0.001	1.98 (1.80 ─ 2.16)	464.42	<0.001	0.50 (0.29 ─ 0.71)	21.04	<0.001

[a]OCP: office clerk personnel, PRO: professional, BS: business service, AWCL: agriculture and water conservancy laborer, PTEO: production of transport equipment operator, UNE: unemployed, OTH: other.
[b]OTH was set as the reference.

Table 4. Relationships between physiques and mother's occupation in the study subjects by using ANCOVA

	Height			Weight			Sitting height			Body fat percentage		
	Beta (95%CI)	**F**	*p*	**Beta (95%CI)**	**F**	*p*	**Beta (95%CI)**	**F**	*p*	**Beta (95%CI)**	**F**	*p*
Boys												
Occupation[a]		13.80	<0.001		16.55	<0.001		13.49	<0.001		12.51	<0.001
OCP	1.13 (-0.66 ─ 2.92)			2.18 (0.37 ─ 3.99)			-0.70 (-1.74 ─ 0.34)			1.35 (0.11 ─ 2.59)		
PRO	-0.71 (-2.12 ─ 2.02)			0.22 (-1.89 ─ 2.33)			-0.46 (-1.67 ─ 0.75)			0.54 (-0.91 ─ 1.99)		
BS	0.20 (-1.21 ─ 1.61)			1.21 (-0.21 ─ 2.63)			-0.23 (-1.05 ─ 0.58)			1.07 (0.09 ─ 2.04)		
AWCL	-5.55 (-6.76 ─ -3.34)			-5.40 (-6.99 ─ -3.81)			-3.31 (-4.23 ─ -2.40)			-2.80 (-3.89 ─ -1.71)		
PTEO	-1.07 (-2.72 ─ 0.57)			-0.28 (-1.93 ─ 1.38)			-0.54 (-1.49 ─ 0.41)			0.34 (-0.80 ─ 1.47)		
UNE	-0.24 (-1.61 ─ 1.14)			0.17 (-1.21 ─ 1.56)			-0.22 (-0.58 ─ 1.01)			0.98 (0.03 ─ 1.94)		
OTH[b]	—			─			─			—		
Age (years)	4.50 (4.22 ─ 4.77)	1034.18	<0.001	2.70 (2.42 ─ 2.98)	367.96	<0.001	1.83 (1.68 ─ 1.99)	514.33	<0.001	0.41 (0.22 ─ 0.60)	17.52	<0.001
Girls												
Occupation		19.82	<0.001		15.62	<0.001		17.48	<0.001		9.96	<0.001
OCP	4.46 (2.39 ─ 6.52)			2.90 (1.17 ─ 4.63)			1.33 (0.18 ─ 2.48)			0.75 (-0.61 ─ 2.10)		
PRO	4.23 (1.97 ─ 6.49)			1.90 (0.01 ─ 3.80)			0.88 (-0.38 ─ 2.14)			-0.18 (-1.67 ─ 1.30)		
BS	2.17 (0.50 ─ 3.84)			1.99 (0.59 ─ 3.39)			0.75 (-0.187 ─ 1.68)			1.12 (0.03 ─ 2.22)		
AWCL	-4.73 (-6.60 ─ -2.86)			-3.59 (-5.16 ─ -2.03)			-3.22 (-4.27 ─ -2.18)			-2.57 (-3.80 ─ -1.34)		
PTEO	2.90 (0.88 ─ 4.92)			2.81 (1.12 ─ 4.50)			1.25 (0.13 ─ 2.38)			1.59 (0.26 ─ 2.91)		
UNE	0.85 (-0.81 ─ 2.51)			1.16 (-0.24 ─ 2.55)			-0.54 (-0.39 ─ 1.46)			0.80 (-0.29 ─ 1.89)		
OTH	─			—			─			─		
Age (years)	4.64 (4.32 ─ 4.96)	795.39	<0.001	2.72 (2.45 ─ 2.99)	389.18	<0.001	2.00 (1.82 ─ 2.18)	475.56	<0.001	0.54 (0.33 ─ 0.75)	24.98	<0.001

[a]OCP:office clerk personnel, PRO: professional, BS: business service, AWCL: agriculture and water conservancy laborer, PTEO: production of transport equipment operator, UNE: unemployed, OTH: other.
[b]OTH was set as the reference.

Table 5. Relationships between physiques and parental education in the study subjects by using ANCOVA

	Height			Weight			Sitting height			Body fat percentage		
	Beta (95%CI)	**F**	*p*	**Beta (95%CI)**	**F**	*p*	**Beta (95%CI)**	**F**	*p*	**Beta (95%CI)**	**F**	*p*
Boys												
Father's education		35.21	<0.001		35.53	<0.001		35.46	<0.001		26.67	<0.001
Primary school or lower	-6.46 (-7.94 ─ -4.97)			-6.45 (-7.96 ─ -4.94)			-3.55 (-4.40 ─ -2.70)			-3.65 (-4.69 ─ -2.61)		
Junior high school	-4.26 (-5.60 ─ -2.93)			-4.59 (-5.95 ─ -3.23)			-2.22 (-2.98 ─ -1.45)			-2.65 (-3.58 ─ -1.71)		
Senior high school	-1.28 (-2.74 ─ 0.19)			-1.33 (-2.82 ─ 0.16)			-0.41 (-1.25 ─ 0.43)			-0.51 (-1.54 ─ 0.51)		
College or higher[a]	—			—			—			—		
Age (years)	4.61 (4.33 ─ 4.88)	1082.76	<0.001	2.79 (2.51 ─ 3.07)	385.67	<0.001	1.89 (1.73 ─ 2.04)	555.12	<0.001	0.43 (0.24 ─ 0.62)	19.09	<0.001
Girls												
Father's education		40.36	<0.001		28.26	<0.001		42.03	<0.001		8.89	<0.001
Primary school or lower	-8.04 (-9.68 ─ -6.41)			-5.47 (-6.85 ─ -4.09)			-4.36 (-5.26 ─ -3.46)			-2.29 (-3.39 ─ -1.19)		
Junior high school	-4.62 (-6.00 ─ -3.24)			-3.24 (-4.40 ─ -2.08)			-2.19 (-2.95 ─ -1.43)			-1.79 (-2.72 ─ -0.87)		
Senior high school	-1.44 (-2.92 ─ 0.05)			-0.76 (-2.01 ─ 0.50)			-0.34 (-1.16 ─ 0.48)			-0.50 (-1.50 ─ -0.50)		
College or higher	─			─			─			─		
Age (years)	4.77 (4.45 ─ 5.08)	863.33	<0.001	2.80 (2.53 ─ 3.07)	41.9.6	<0.001	2.09 (1.92 ─ 2.27)	549.76	<0.001	0.59 (0.38 ─ 0.80)	29.20	<0.001
Boys												
Mother's education		32.70	<0.001		36.14	<0.001		19.49	<0.001		24.35	<0.001
Primary school or lower	-5.45 (-6.91 ─ -3.98)			-6.07 (-7.55 ─ -4.60)			-2.72 (-3.58 ─ -1.86)			-3.58 (-4.60 ─ -2.56)		
Junior high school	-3.14 (-4.60 ─ -1.68)			-3.59 (-5.06 ─ -2.12)			-1.87 (-2.73 ─ -1.02)			-2.71 (-3.72 ─ -1.69)		
Senior high school	0.19 (-1.83 ─ 1.44)			0.74 (-2.38 ─0.91)			-0.56 (-1.57 ─ 0.40)			-0.78 (-1.91 ─ 0.36)		
College or higher	─			—			—			─		
Age (years)	4.65 (4.37 ─ 4.92)	1114.96	<0.001	2.87 (2.59 ─ 3.14)	419.67	<0.001	1.89 (1.73 ─ 2.05)	536.49	<0.001	0.48 (0.29 ─ 0.67)	22.44	<0.001
Girls												
Mother's education		34.51	<0.001		24.79	<0.001		21.39	<0.001		5.57	<0.001
Primary school or lower	-7.33 (-8.87 ─ -5.79)			-5.26 (-6.56 ─ -3.96)			-3.30 (-4.17 ─ -2.43)			-2.04 (-3.08 ─ -1.01)		
Junior high school	-3.94 (-5.47 ─ -2.40)			-2.95 (-4.25 ─ -1.66)			-1.70 (-2.56 ─ -0.83)			-1.38 (-2.40 ─ -0.35)		
Senior high school	-2.44 (-4.17 ─ 0.70)			-1.78 (-3.25 ─ -0.32)			-1.28 (-2.26 ─ -0.30)			-0.85 (-2.01 ─ 0.32)		
College or higher	─			─			─			─		
Age (years)	4.84 (4.52 ─ 5.17)	868.47	<0.001	2.88 (2.67 ─ 3.15)	433.50	<0.001	2.12 (1.93 ─ 2.30)	519.76	<0.001	0.62 (0.41 ─ 0.84)	32.14	<0.001

[a]College or higher was set as the reference.

Table 6. Relationships between physiques and family monthly income in the study subjects by using ANCOVA

	Height			Weight			Sitting height			Body fat percentage		
	Beta (95%CI)	**F**	*p*	**Beta (95%CI)**	**F**	*p*	**Beta (95%CI)**	**F**	*p*	**Beta (95%CI)**	**F**	*p*
Boys												
Family monthly income		55.51	<0.001		40.55	<0.001		45.91	<0.001		28.00	<0.001
≤2000	-5.68 (-6.77 ─ -5.00)			-4.88 (-5.97 ─ -3.79)			-3.07 (-3.70 ─ -2.43)			-2.87 (-3.62 ─ -2.11)		
2001–5000	-1.93 (-2.99 ─ -0.87)			-1.74 (-2.80 ─ -0.68)			-1.22 (-1.84 ─ -0.60)			-1.49 (-2.22 ─ -0.76)		
5001≤[a]	─			─			─			─		
Age (years)	4.73 (4.4 ─ 5.01)			2.97 (2.69 ─ 3.25)	435.46	<0.001	1.93 (1.77 ─ 2.10)	536.81	<0.001	0.54 (0.35 ─ 0.73)	30.23	<0.001
Girls												
Family monthly income		50.35	<0.001		38.55	<0.001		34.48	<0.001		13.05	<0.001
≤2000	-6.22 (-7.46 ─ -4.99)			-4.43 (-5.48 ─ -3.38)			-2.92 (-3.61 ─ -2.22)			-1.94 (-2.79 ─ -1.09)		
2001–5000	-2.10 (-3.33 ─ -0.87)			-0.89 (-1.93 ─ 0.15)			-1.13 (-1.82 ─ -0.44)			-0.07 (-0.91 ─ 0.77)		
5001≤	─			─			─			—		
Age (years)	5.00 (4.64 ─ 5.31)	858.88	<0.001	3.00 (2.68 ─ 3.24)	423.51	<0.001	2.14 (1.95 ─ 2.33)	504.53	<0.001	0.63 (0.41 ─ 0.86)	29.66	<0.001

[a]5001≤ was set as the reference.

Table 7. Associations between physiques and socioeconomic situation in the three groups by using ANCOVA (boys)

	Height			Weight			Sitting height			Body fat percentage		
	Beta (95%CI)	**F**	*p*	**Beta (95%CI)**	**F**	*p*	**Beta (95%CI)**	**F**	*p*	**Beta (95%CI)**	**F**	*p*
Father's occupation		0.87			1.93			2.24	<0.05		2.81	<0.05
Group		155.60	<0.001		149.78	<0.001		168.00	<0.001		102.89	<0.001
1	-6.80 (-9.24 ─ -4.37)			-7.63 (-10.12 ─ -5.15)			-3.96 (-5.34 ─ -2.57)			-3.41 (-5.17 ─ -1.64)		
2 [a]	─			—			─			─		
3	4.11 (1.40 ─ 6.81)			4.81 (2.04 ─ 7.57)			0.84 (-0.70 ─ 2.37)			2.55 (0.59 ─ 4.51)		
Age	4.86 (4.61 ─ 5.10)	1512.27	<0.001	3.04 (2.79 ─ 3.29)	569.12	<0.001	2.04 (1.90 ─ 2.18)	828.55	<0.001	0.62 (0.45 ─ 0.80)	47.93	<0.001
Mother's occupation		1.35			1.01			3.11	<0.05		0.72	
Group		160.56	<0.001		136.52	<0.001		198.15	<0.001		106.03	<0.001
1	-6.52 (-8.82 ─ -4.22)			-8.00 (-10.32 ─ -5.65)			-4.14 (-5.44 ─ -2.83)			4.24 (-5.89 ─ -2.59)		
2	─			—			─			─		
3	4.93 (2.61 ─ 7.25)			4.30 (1.95 ─ 6.65)			1.31 (-0.01 ─ 2.62)			2.03 (0.37 ─ 3.70)		
Age	4.86 (4.62 ─ 5.12)	1543.62	<0.001	3.08 (2.83 ─ 3.33)	586.10	<0.001	2.07 (1.93 ─ 2.21)	845.04	<0.001	0.64 (0.46 ─ 0.82)	50.60	<0.001
Father's education		0.37			0.34			1.93			1.16	
Group		68.85	<0.001		70.12	<0.001		58.90	<0.001		45.18	<0.001
1	-5.98 (-10.88 ─ -1.08)			-9.50 (-14.52 ─ -4.49)			-3.15 (-5.94 ─ -0.37)			-4.51 (-8.07 ─ -0.94)		
2	─			─			─			─		
3	5.57 (3.18 ─ 7.96)			3.05 (0.60 ─ 5.50)			1.85 (0.49 ─ 3.21)			1.96 (0.22 ─ 3.71)		
Age	4.92 (4.68 ─ 5.17)	1537.70	<0.001	3.12 (2.87 ─ 3.37)	589.82	<0.001	2.10 (1.96 ─ 2.24)	863.60	<0.001	0.65 (0.47 ─ 0.82)	49.76	<0.001
Mother's education		0.63			0.42			0.94			0.53	
Group		80.35	<0.001		74.93	<0.001		68.83	<0.001		44.89	<0.001
1	-5.82 (-12.15 ─ 0.50)			-7.24 (-13.67 ─ -0.81)			-3.14 (-6.78 ─ 0.50)			-4.59 (-9.15 ─ 0.03)		
2	─			─			─			—		
3	7.08 (4.59 ─ 9.59)			5.47 (2.93 ─ 8.01)			2.48 (1.04 ─ 3.92)			2.40 (0.59 ─ 4.20)		
Age	4.88 (4.64 ─ 5.12)	1567.60	<0.001	3.11 (2.86 ─ 3.35)	615.83	<0.001	2.05 (1.91 ─ 2.19)	837.88	<0.001	0.64 (0.47 ─ 0.81)	51.83	<0.001
Family monthly income		3.04	<0.05		0.58			1.33			1.66	
Group		135.67	<0.001		122.80	<0.001		134.64	<0.001		79.08	<0.001
1	-9.93 (-12.83 ─ -7.02)			-7.79 (-10.71 ─ -4.87)			-5.56 (-7.24 ─ -3.89)			-3.85 (-5.91 ─ 1.78)		
2	─			─			─			─		
3	3.63 (2.16 ─ -5.10)			3.59 (2.12 ─ 5.07)			0.94 (0.09 ─ 1.79)			1.38 (0.33 ─ 2.43)		
Age	4.93 (4.68 ─ 5.18)	1488.72	<0.001	3.16 (2.90 ─ 3.41)	605.98	<0.001	2.06 (1.91 ─ 2.20)	780.33	<0.001	0.68 (0.50 ─ 0.85)	55.36	<0.001

Data were assessed by ANCOVA. Group 2 was set as the reference.

Table 8. Associations between physiques and socioeconomic situation in the three groups by using ANCOVA (girls)

	Height			Weight			Sitting height			Body fat percentage		
	Beta (95%CI)	**F**	*p*	**Beta (95%CI)**	**F**	*p*	**Beta (95%CI)**	**F**	*p*	**Beta (95%CI)**	**F**	*p*
Father's occupation		1.13			1.05			0.76			1.05	
Group		83.42	<0.001		82.48	<0.001		106.76	<0.001		36.48	<0.001
1	-5.32 (-8.09 ─ -2.57)			-4.92 (-7.26 ─ -2.59)			-1.77 (-3.28 ─ -0.26)			-3.91 (-5.8 5─ -1.97)		
2 [a]	─			─			—			—		
3	7.29 (4.34 ─ 10.25)			4.38 (1.88 ─ 6.88)			3.30 (1.68 ─ 4.92)			1.45 (-0.62 ─ 3.53)		
Age	5.06 (4.76 ─ 5.36)	1093.38	<0.001	3.03 (2.78 ─ 3.29)	549.71	<0.001	2.25 (2.09 ─ 2.42)	722.55	<0.001	0.73 (0.52 ─ 0.95)	46.69	<0.001
Mother's occupation		1.80			0.90			0.51			0.49	
Group		104.98	<0.001		87.93	<0.001		139.69	<0.001		39.54	<0.001
1	-5.63 (-8.56 ─ -2.70)			-3.92 (-6.37 ─ -1.47)			-2.76 (-4.36 ─ -1.16)			2.35 (-4.36 ─ -0.34)		
2	─			─			—			—		
3	5.77 (2.69 ─ 8.85)			6.10 (3.52 ─ 8.67)			2.61 (0.93 ─ 4.29)			3.47 (1.36 ─ 5.58)		
Age	5.03 (4.74 ─ 5.33)	1122.30	<0.001	3.06 (2.82 ─ 3.31)	594.04	<0.001	2.25 (2.09 ─ 2.41)	749.54	<0.001	0.75 (0.55 ─ 0.96)	53.37	<0.001
Father's education		1.11			0.74			2.58			0.74	
Group		50.73	<0.001		57.35	<0.001		60.51	<0.001		30.23	<0.001
1	-6.17(-11.12 ─ -1.21)			-8.05 (-12.23 ─ -3.87)			-5.21 (-7.92 ─ -2.50)			-3.31 (-6.77 ─ 0.15)		
2	─			─			—			—		
3	4.85 (2.19 ─ 7.52)			1.84 (-0.41 ─ 4.09)			1.07 (-0.39 ─ 2.53)			-0.78 (-2.64 ─ 1.08)		
Age	4.98 (4.69 ─ 5.27)	1133.19	<0.001	3.01 (2.77 ─ 3.26)	581.97	<0.001	2.26 (2.10 ─ 2.42)	776.52	<0.001	0.77 (0.57 ─ 0.98)	55.94	<0.001
Mother's education		1.61			0.22			1.08			1.00	
Group		60.01	<0.001		56.79	<0.001		67.73	<0.001		25.55	<0.001
1	-4.57 (-10.92 ─ 1.77)			-6.88 (-12.24 ─ -1.51)			-3.29 (-6.79 ─ 0.21)			-1.79 (-6.22 ─ 2.65)		
2	─			─			—			—		
3	7.49 (4.24 ─ 10.75)			2.44 (-0.31 ─ 5.19)			2.78 (0.98 ─ 4.57)			0.18 (-2.10 ─ 2.45)		
Age	5.02 (4.73 ─ 5.31)	1157.33	<0.001	3.05 (2.81 — 3.30)	596.80	<0.001	2.23 (2.07 ─ 2.39)	752.18	<0.001	0.76 (0.56 ─ 0.96)	54.05	<0.001
Family monthly income		2.74			2.93			0.09			1.47	
Group		74.73	<0.001		68.38	<0.001		1144.16	<0.001		42.14	<0.001
1	-7.85 (-11.70 ─ -4.00)			-7.24 (-10.51 — -3.97)			-4.08 (-6.20 ─ -1.95)			-5.50 (-8.22 ─ -2.78)		
2	─			─			—			—		
3	4.21 (2.29 ─ -6.13)			1.79 (0.16 ─ 3.42)			1.69 (0.6 3 ─ 2.75)			0.18 (-1.18 ─ 1.54)		
Age	5.09 (4.79 ─ 5.40)	1072.88	<0.001	3.08 (2.82 ─ 3.34)	543.17	<0.001	2.23 (2.06 ─ 2.39)	672.58	<0.001	0.73 (0.51 ─ 0.94)	43.55	<0.001

Data were assessed by ANCOVA. Group 2 was set as the reference.

Table 9. Associations between socioeconomic and lifestyle behavior factors and physical characteristics in migrant peasant worker's children

	Height				Weight				BMI			
	$<P_{15}$	P_{15}–P_{85}	$P_{85}<$	*p*	$<P_{15}$	P_{15}–P_{85}	$P_{85}<$	*p*	$<P_{15}$	P_{15}–P_{85}	$P_{85}<$	*p*
	n = 137 (%)	n = 641 (%)	n = 136 (%)		n = 142 (%)	n = 635 (%)	n = 137 (%)		n = 138 (%)	n = 641 (%)	n = 135 (%)	
Socioeconomic factors												
Duration of living in Shanghai (<60 months)	88 (64.2)	368 (57.4)	67 (49.3)	0.043*	87 (61.3)	372 (58.6)	64 (46.7)	0.022*	75 (54.3)	380 (59.3)	68 (50.4)	0.125
Family monthly income (≤2000yuan)	51 (41.1)	181 (31.0)	36 (28.1)	0.043*	48 (37.2)	189 (32.3)	31 (25.8)	0.156	38 (30.2)	193 (32.7)	37 (31.4)	0.847
Father's occupation (unemployed)	24 (17.8)	75 (12.3)	15 (11.5)	0.471	26 (18.6)	74 (12.3)	14 (10.7)	0.066	17 (12.7)	87 (14.3)	10 (7.6)	0.047*
Mother's occupation (unemployed)	56 (41.5)	301 (48.9)	71 (54.2)	0.186	62 (45.6)	291 (47.5)	75 (56.0)	0.103	56 (42.7)	306 (49.5)	66 (49.6)	0.072
Father's education (primary school or lower)	37 (27.6)	127 (20.9)	30 (22.7)	0.360	32 (23.0)	131 (21.7)	31 (23.7)	0.586	30 (22.4)	124 (20.4)	40 (30.8)	0.017*
Mother's education(primary school or lower)	67 (49.6)	268 (43.3)	52 (39.4)	0.246	63 (46.0)	268 (43.5)	56 (42.1)	0.727	63 (47.7)	271 (43.5)	53 (40.5)	0.224
House size (≤30m^2)	85 (64.4)	311 (49.6)	53 (39.6)	0.001*	80 (58.4)	305 (49.2)	64 (47.1)	0.347	69 (51.1)	311 (49.8)	69 (51.9)	0.795
Child's bedroom(-)	113 (83.7)	476 (76.3)	91 (68.9)	0.018*	118 (84.3)	467 (75.4)	95 (72.0)	0.038*	108 (81.2)	471 (75.2)	101 (76.5)	0.339
Lifestyle behavior factors												
Method of getting to school (on foot)	102 (75.0)	480 (77.3)	104 (79.4)	0.693	109 (77.3)	482 (78.5)	95 (71.4)	0.211	107 (80.5)	485 (77.7)	94 (71.8)	0.212
Duration of physical activity(≤30 min/day)	9 (6.8)	52 (8.4)	8 (6.2)	0.622	11 (8.1)	52 (8.4)	6 (4.7)	0.357	11 (8.2)	51 (8.3)	7 (5.3)	0.519
Watching TV, playing video games or using computers (≥3h/day)	32 (23.4)	166 (26.8)	48 (37.2)	0.057	33 (23.6)	174 (28.4)	39 (29.3)	0.734	32 (23.7)	178 (28.8)	36 (27.1)	0.739
Picky eating(+)	95 (72.5)	438 (70.3)	90 (68.7)	0.792	96 (69.6)	443 (72.1)	84 (63.2)	0.017*	92 (69.2)	443 (71.5)	88 (66.7)	0.520

*p <0.05, statistically significant difference

Table 10. Associations between socioeconomic and lifestyle behavior factors and physical characteristics using simple logistic regression analyses

	Duration of living in Shanghai City(<60 months)	Family monthly income (≤2000yuan)	Father's occupation (unemployed)	Mother's occupation (unemployed)	Father's education (primary school or lower)	Mother's education (primary school or lower)
	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
Height						
P_{15}–P_{85}	1	1	1	1	1	1
<P_{15}	1.33 (0.91 – 1.95)	1.55 (1.04 – 2.31)	1.54 (0.91 – 2.61)	0.85 (0.53 – 1.35)	1.19 (0.59 – 2.41)	1.46 (0.59 – 3.59)
P_{85}<	0.72 (0.50 – 1.04)	0.87 (0.57 – 1.33)	0.84 (0.46 – 1.53)	1.92* (1.12 – 3.31)	1.25 (0.57 – 2.74)	1.02 (0.50 – 2.08)
Weight						
P_{15}–P_{85}	1	1	1	1	1	1
<P_{15}	1.12 (0.77 – 1.62)	1.25 (0.84 – 1.85)	2.05* (1.22 – 3.46)	0.96 (0.61 – 1.52)	1.65 (0.71 – 3.81)	1.96 (0.75 – 5.16)
P_{85}<	0.62* (0.43 – 0.90)	0.73 (0.47 – 1.14)	0.81 (0.43 – 1.50)	2.72* (1.51 – 4.88)	0.91 (0.45 – 1.85)	1.11 (0.50 – 2.31)
BMI						
P_{15}–P_{85}	1	1	1	1	1	1
<P_{15}	0.82 (0.57 – 1.18)	0.89 (0.59 – 1.35)	1.46 (0.59 – 1.90)	0.72 (0.46 – 1.14)	3.57* (1.20 – 10.60)	3.02* (1.05 – 8.67)
P_{85}<	0.70 (0.48 – 1.01)	0.94 (0.62 – 1.44)	0.48* (0.24 – 0.97)	1.62 (0.95 – 2.78)	0.92 (0.72 – 2.94)	1.09 (0.69 – 4.15)

	House size(≤30m^2)	Without child's bedroom	Going to school on foot	Duration of physical activity (≤30 min/day)	Watching TV, playing video games or using computers (≥3h/day)	Picky eating
	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)	OR (95%CI)
Height						
P_{15}–P_{85}	1	1	1	1	1	1
<P_{15}	3.83 (0.89 – 16.39)	1.45 (0.96 – 2.19)	0.88 (0.57 – 1.36)	0.79 (0.38 – 1.65)	1.28 (0.82 – 1.99)	1.12 (0.73 – 1.70)
P_{85}<	0.53 (0.24 – 1.19)	0.63 (0.38 – 1.03)	1.13. (0.71 – 1.80)	0.72 (0.33 – 1.56)	0.64* (0.43 – 0.97)	0.93 (0.62 – 1.39)
Weight						
P_{15}–P_{85}	1	1	1	1	1	1
<P_{15}	3.67 (0.86 – 15.74)	1.20 (0.79 – 1.82)	0.93 (0.60 – 1.45)	0.96 (0.49 – 1.89)	1.33 (0.86 – 2.07)	0.88 (0.59 – 1.32)
P_{85}<	0.65 (0.29 – 1.45)	0.57* (0.35 – 0.94)	0.69 (0.45 – 1.05)	0.54 (0.23 – 1.27)	0.97 (0.63 – 1.48)	0.66* (0.45 – 0.98)
BMI						
P_{15}–P_{85}	1	1	1	1	1	1
<P_{15}	1.44 (0.49 – 4.27)	0.93 (0.60 – 1.45)	1.18 (0.74 – 1.88)	0.99 (0.50 – 1.96)	1.31 (0.84 – 2.04)	0.90 (0.60 – 1.35)
P_{85}<	0.64 (0.29 – 1.43)	0.70 (0.44 – 1.13)	0.73 (0.48 – 1.11)	0.63 (0.28 – 1.41)	1.05 (0.68 – 1.63)	0.80 (0.54 – 1.19)

*p <0.05, statistically significance, OR: odds ratio, 95%CI: 95% confidence interval