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The Growth of Body Size and Somatotype of Javanese Children Age 4 to 20 Years

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Growth of body size (body height and body weight) and somatotype in 363 girls and 299 boys aged 4 to 20 years of ethnic Javanese lived in Magelang Regency Indonesia were studied cross-sectionally. Over half of them were categorized in the well-off family, therefore underweight or underfat prevalence in our subjects was low (14.3%) but overweight and obesity prevalence was also low (14%). They were shorter and lighter than reference children from U.S., Japan and Yogyakarta but they improved when compared with those of the same ethnic of Bantul and with the different ethnic of rural India. There was a clear age-related change of their somatotype. At age 4 years, the physique of children subjects in both sexes is found to be mesomorph-endomorph. Thereafter it is transformed into ectomorphic-endomorph in girls and to mesomorph-ectomorph in boys at the age of 20 years. In girl subjects, the onset of puberty was characterized by an acceleration of endomorphy component at age 8 years. While in our boys it was characterized by an acceleration of ectomorphy since age 9 years. The different growth pattern of somatotype components showed that the use of BMI as an indicator of fatness in children should be reassessed.

Key words: growth, Javanese children, body size, body mass index, somatotype

INTRODUCTION

Numerous studies have been carried out in Indonesia to evaluate variations of the principal anthropometric characteristics in relation to growth (Adhianto & Soetjiningsih 2002; Puspita 2004; Rahmawati *et al*. 2004; Waters *et al*. 2004; Artaria & Henneberg 2007; Hermawan 2007; Miharja 2008; Tuan & Nicklas 2009; Aryo 2011). Growth is the best global indicator of children's well-being. It is the single measurement that best defines the health and nutritional status of children, just as it provides an indirect measurement of the quality of life of an entire population (de Onis & Blössner 2003). During the human growth, the body changes significantly in size and shape (Kalichman & Kobyliansky 2006). Body weight and body height are the main dimensions of body size.

Based on the 2-component model of body composition (Ellis 2000), body weight consists of fat mass and fat free mass. Fat mass is the most variable component of the body. A common indicator for fat mass is body mass index (BMI) (Dietz & Bellizzi 1999; Chakraborty *et al*. 2009; Kulkarni *et al*. 2010), which is defined by World Health Organization (WHO) as a simple index of weight-for-height (http://apps.who.int/bmi/index.jsp). It has been recommended as the best measurement for monitoring overall body adiposity in the majority of large-scales studies although BMI does not singly quantitate body fat as it amalgamates frame size (which reflects mineral content) and lean tissue (Roemmich *et al*. 1997; Fields & Goran 2000). On the other hand, skinfold thickness is widely used as a measure of fatness (Norgan 2005). It has most of the characteristics of a good field method to measure level of fatness because it directly measures subcutaneous fat layers. Nevertheless, a study of body weight and height only is not always sufficient enough to produce complete information regarding child physique and growth (Özener & Duyar 2008).

Independent of body size, a somatotype is a convenient shorthand descriptor of overall physique in terms of body shape and composition (Carter 1996). It reflects an overall outlook of the body and conveys a meaning of the totality of morphological features of the human body (Singh *et al*. 2007). A three-exact decimal score of component of somatotype refers to endomorphy (representing relative fatness), mesomorphy (representing relative muscularity) and ectomorphy (representing relative linearity) (Carter 2002). Somatotype has often been used to study morphometric variations in human body (Singh *et al*. 2007). Changes in somatotype components during the growth period can provide useful information about the growth status and the timing and rate of sexual maturation (Beunen *et al*. 1987; Hebbelinck *et al*. 1995; Toselli & Gruppioni 1999). Many studies were carried out in the Caucasoid children (Gakhar & Malik 2002; Ghosh & Malik 2004; Kalichman & Kobyliansky 2006; Bhasin & Jain 2007; Singh *et al*. 2007; Özener & Duyar 2008; Ventrella *et al*. 2008). Studies on somatotype in Indonesian children had not been well described excepting some reports from Rahmawati *et al*. (2004) and Aryo (2011).

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Indonesia has a wide variety of ethnological groups so it is important to carry out research into the growth of body size and somatotype. In the present study, we selected children from the Javanese population in Magelang Regency. The purpose of the study is to evaluate growth of body size (height and weight) and somatotype in the Javanese children aged 4 to 20 years from Magelang Regency. The growth of body size of the Magelang children is compared to that of several reference populations. Data recommended by the 2002 National Health Examination Surveys (NHES) and National Health and Nutrition Examination Surveys (NHANES) reference population (NHES & NHANES 2002) are the most suitable for use as an international growth reference (Bener & Kamal 2005). We also used reference children living in Japan (Kimura 1984), India (Venkaiah *et al*. 2002), and Indonesia (Bantul and Yogyakarta) (Rahmawati *et al*. 2004).

MATERIALS AND METHODS

Subjects. The subjects were ethnic Javanese lived in Magelang Regency. Magelang Regency is mainly a rural region with a land area of 1,085.73 km^2 comprised of 21 sub-districts. The regency is located in the Kedu Plain between Mount Merbabu, Mount Sumbing and Mount Merapi in Central Java, Indonesia (Figure 1). *It* has an average elevation of about 360 meters *above sea level*. The regency is located 43 km north of Yogyakarta and 75 km south of Semarang, the capital of Central Java. According to the Indonesia's Central Agency on Statistics (BPS 2006), it had an estimated population of 1,179,867 with age cohort 0 to 24 years comprised of 276,642 boys and 263,285 girls. A cross-sectional growth study was conducted during October 2008 to October 2009. Before enrolling, all the parents or child guardians were sent a letter with detailed information, in which their children were invited to participate in the study. If they approved to participate, they were asked to write an informed consent and completed a questionnaire on their child's birth dates, ethnicity and other demographic data. Age (in year) was determined by calculating the difference between the date of measurement and the date of birth and the difference was divided by 365.25 days. In trying to get growth norms, we eliminated outliers because they may be suspected as in abnormal health condition. These outliers were detected as individuals beyond 3rd and 97th percentiles in preliminary analysis of the whole data (see Data Analysis).

Measurements. In order to determine body size and somatotype we measured 10 anthropometric measurements, i.e. body weight (WT), body height (HT), triceps skinfold, subscapular skinfold, supraspinale skinfold, calf skinfold, humerus breadth, femur breadth, upper-arm girth, and calf girth. We followed the anthropometric measurement manual of NHANES III (1988). WT and HT are the main dimensions of body size.

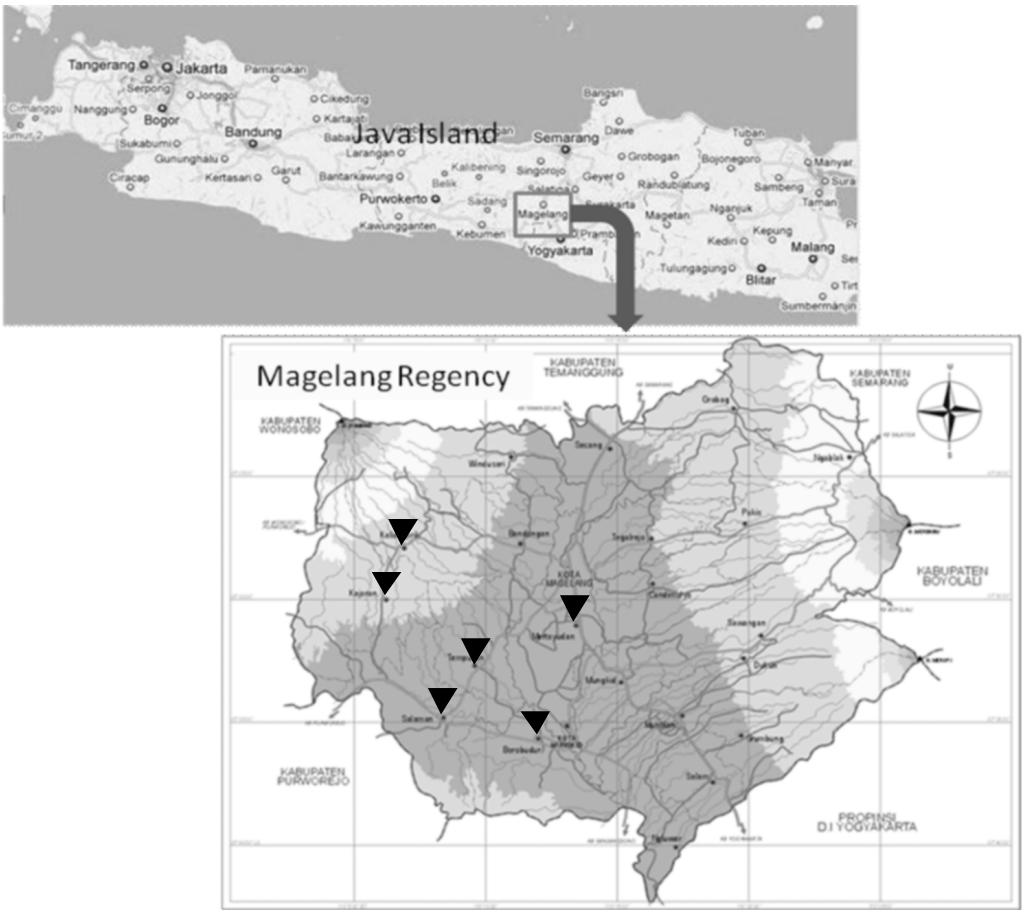

Figure 1. Map of Magelang Regency in Central Java Province Indonesia showing the study sites (▼).