Short Communication

Weight and height faltering in the indigenous children (*Orang Asli*) of Peninsular Malaysia during the first 2 years of life

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Background and Objectives: Information on the growth status of indigenous children is useful for developing intervention strategies, but the data are limited. This study determined the prevalence of undernutrition among under-five indigenous children (*Orang Asli*) and tracked the growth status of *Orang Asli* children aged 0–3 years. **Methods and Study Design:** This study had two phases: a cross-sectional growth study of under-five *Orang Asli* children (N=304; Phase 1) and a 2-year prospective cohort growth study of *Orang Asli* children aged 0–3 years (N=214; Phase 2) in the Temerloh district of Pahang, Malaysia. Weight-for-age, length/height-for-age, weight-for-length/height, and body mass index-for-age were determined. **Results:** The prevalence rates of stunting, underweight, wasting, and thinness in under-five *Orang Asli* children (Phase 1) were 64%, 49%, 14%, and 12%, respectively. In the cohort of 214 children (Phase 2), weight-for-age was initially documented and maintained closely at −1.50 standard deviations (SD) in the first 6 months, but it declined to approximately −2.00 SD at 15 months and remained close to −2.00 SD thereafter. Length/height-for-age declined rapidly to approximately −2.50 SD at 18 months and fluctuated between −2.30 and −2.50 SD thereafter. Weight-for-length/height increased sharply to −0.40 SD at 2–3 months, declined gradually to less than −1.00 SD at 12 months, and plateaued between −1.00 and −1.30 SD thereafter. **Conclusions:** Undernutrition is prevalent among *Orang Asli* children, with length rather than weight faltering being more pronounced in the first 2 years of life. Identifying the causes of early growth retardation in this population is required to inform future preventive strategies.

Key Words: undernutrition, growth faltering, *Orang Asli* children, Peninsular Malaysia, prospective cohort study

INTRODUCTION

Although indigenous populations account for only approximately 4.5% (approximately 300 million) of the global population, they are among the poorest and most marginalised groups, with poor health and social outcomes.[1] Studies have reported that undernutrition is prevalent among indigenous children (aged <5 years), whereby 44%–75% of indigenous children in Mexico, Guatemala, and India are stunted, and 19%–55% are underweight.[2-4]

The first 2 years of a child's life are recognised as a critical period of growth and development.[4-5] During this period, optimal energy and nutrients are required to meet the metabolic and physiological demands of growth and development.[6] Inadequate energy and nutrient intake coupled with recurrent infections may lead to subsequent metabolic compromise and hence to infant growth retardation.[6] Data from low- and middle-income countries revealed that infants often experience significant growth faltering in the first 2 years of life.[5] Early childhood growth retardation is associated with increased morbidity and mortality from infections, impaired cognitive development, and reduced educational performance.[7-8] This nutrition problem could also adversely affect adult stature, economic productivity, and birth weight of offspring (for women) and increase the risk of several chronic diseases in adulthood.[9-10]

Although the indigenous peoples of Peninsular Malaysia (*Orang Asli*) contribute to only approximately 0.6% of the Malaysian population, a high prevalence of underweight and stunting (43%–86%) have been reported among *Orang Asli* children aged 1–6 years.[11-15] To date, published information on the growth patterns of the world's indigenous children and Malaysia's *Orang Asli* children is limited, and most of this published information was based on cross-sectional studies.[16-19] Only a few cohort studies examined the growth of indigenous children during the first 5 years of life.[20-22] This study was conducted in two phases in an *Orang Asli* community in the

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Temerloh district of Pahang, Malaysia. A cross-sectional study (Phase 1) was performed to assess the nutritional status of under-five *Orang Asli* children and a 2-year prospective cohort study (Phase 2) examined the growth of *Orang Asli* children aged 0–3 years.

METHODS

Study design, setting, and subjects

This study was part of a larger study on the health and nutrition of *Orang Asli* adults and children in the Temerloh district of Pahang, Malaysia. This district was purposively selected because it has a high *Orang Asli* population relative to other districts in Pahang. There are 19 *Orang Asli* villages in the Temerloh district, with approximately 6817 residents.[23] The present study was conducted in two phases.

Phase 1

A cross-sectional study was conducted in 11 *Orang Asli* villages surrounding the Krau Wildlife Reserve (KWR), which is located near the Benom Mountain in the Temerloh district of Pahang, Malaysia. There are 833 indigenous households in this reserve, with approximately 3636 residents.[23] The major subtribes living in the areas surrounding this reserve are *Jah Hut* and *Che Wong* of the *Senoi* tribal group, and *Temuan* of the *Proto Malay* tribal group.[23] From October 2011 to January 2012, 250 households that met study criteria consented for their 363 under-five children with no health disabilities to participate in the study; these households were of the *Jah Hut*, *Temuan*, and *Che Wong* subtribes. However, only 304 children (83.7%) from 220 households completed the weight and height measurements (Figure 1).

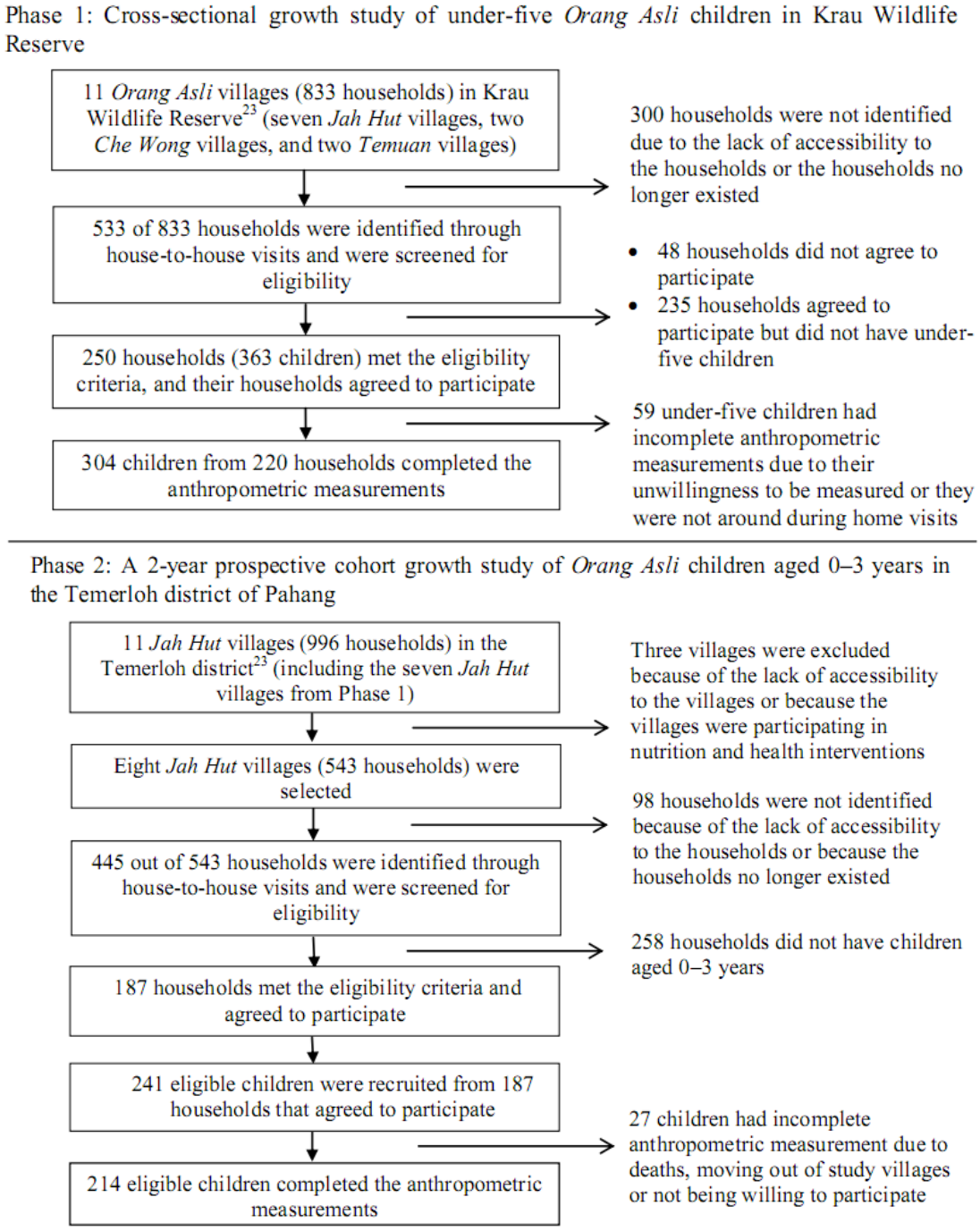

Figure 1. Flowchart of the sampling process

Phase 2

According to the findings of Phase 1, under-five stunting was highly prevalent among *Jah Hut* children. Therefore, a 2-year prospective cohort study was designed to track the growth of these children. *Jah Hut* is the predominant subtribe of *Orang Asli* in the Temerloh district of Pahang, Malaysia. There are 11 *Jah Hut* villages in the Temerloh district, with approximately 4615 residents living in 996 households; these residents represent approximately 68% of the *Orang Asli* in the district.[23] Eight *Jah Hut* villages, which are located in the Temerloh district, were selected for this study. From the eight selected villages, 241 children with no health disabilities who had been born between November 2008 and September 2012 were recruited, and their families agreed to let them participate in the study. However, only 214 children completed at least eight measurements of weight and height over the 2-year study period (Figure 1). Eligible children were then categorised into six age groups: 0–5.9 months (n=87), 6–11.9 months (n=40), 12–17.9 months (n=20), 18–23.9 months (n=29), 24–29.9 months (n=30), and 30–36 months (n=35). For infants aged 0–5.9 months, visits were conducted once a month in the first 6 months of life and subsequently every 3 months at 9, 12, 15, 18, 21, and 24 months of age for weight and length measurements. For infants and children who were not recruited from birth, data on the weight and length before recruitment were obtained from health records. Subsequent weight and length/height measurements were obtained every 3 months over a 2-year period. For example, a child recruited at 18 months of age would have his/her weight and length/height measured at 21, 24, 27, 30, 33, 36, 39, and 42 months of age.

Measures

Information on the ethnicity, sex, and age of the children was obtained from the parents through an interviewer-administered questionnaire. Age was recorded from identification cards or birth certificates. Anthropometric measurements were collected by three well-trained research assistants. Weight was measured to the nearest 0.1 kg and height to the nearest 0.1 cm by using a Tanita digital weighing scale and Seca stadiometer, respectively, for children aged ≥2 years. The recumbent weight and length of infants and young children aged <2 years were measured to the nearest 0.01 kg and 0.1 cm, respectively, by using a Seca infantometer. Age- and sex-specific z-scores for weight-for-age (WAZ), length/height-for-age (L/HAZ), weight-for-length/height (WL/HZ), and body mass index-for-age (BAZ) of children (aged <5 years) were calculated using WHO Anthro software (version 3, 2009). Underweight, stunting, wasting, and thinness among children were defined as WAZ, L/HAZ, WL/HZ, and BAZ of less than -2 standard deviations (SD).[24]

Ethical approval

The study protocol was approved by the Medical Research Ethics and Committee of the Faculty of Medicine and Health Sciences, Universiti Putra Malaysia (UPM/FPSK/PADS/T7-MJKEtikaPer/F01 LECT(JPD)_ Jun(11)06). Permission to conduct this study was obtained from the Malaysian Department of *Orang Asli* Development and Department of Wildlife and National Parks, Peninsular Malaysia. Parents gave written or verbal consent prior to data collection.

Statistical analysis

IBM SPSS Statistics 20.0 and Microsoft Excel 2010 were used for data analysis. All variables are presented as mean, standard deviation, and frequency. In Phase 1, the z-score distribution of different anthropometric indicators was plotted, and the chi-square test for linear associations was used to determine the trend of undernutrition across the seven age categories. In Phase 2, the growth pattern of *Orang Asli* children during the first 5 years of life was plotted based on the mean anthropometric z-score, and one-way repeated measures ANOVA was conducted to test the significant differences in the mean anthropometric z-scores during the first 24 months of age. Statistical significance was set at $p<0.05$.

RESULTS

Phase 1

The participants of this study comprised 87.5% *Jah Hut*,

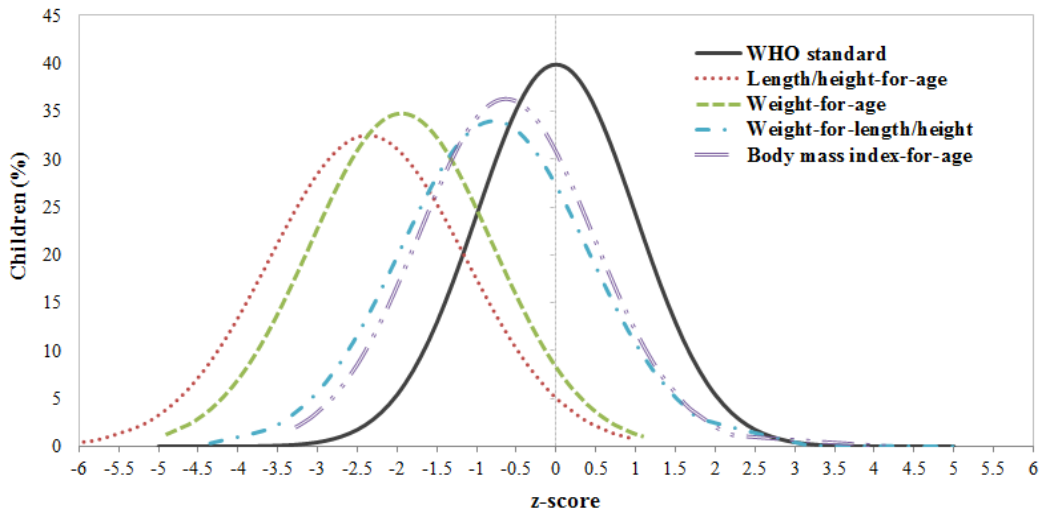

Figure 2. z-score distribution for length/height-for-age, weight-for-age, weight-for-length/height, and body mass index-for-age of under-five *Orang Asli* children compared with the World Health Organization standard [N=304].

7.6% *Temuan*, and 4.9% *Che Wong* under-five children. There were 53.3% and 46.7% of boys and girls, respectively, with a mean age of 27.5±18.0 months. Approximately one-third of the under-five children (32.3%) had low birth weight (<2500 g), whereas 25% were born prematurely (<37 weeks). Approximately 83% of children were living in households with a per capita monthly income that was below the poverty line for Peninsular Malaysia [i.e. USD 58.02 (RM 194)].

Figure 2 illustrates the z-score distribution of the growth indicators in indigenous children. The HAZ and WAZ distributions were skewed far to the left of the WHO standard, whereas the distributions of BAZ and WHZ appeared to be skewed only slightly to the left. Overall, the prevalence rate of under-five stunting (64%) was higher than the prevalence rates of underweight (49%), wasting (14%), and thinness (12%). The percentage of concurrent stunting and underweight among under-five *Orang Asli* children was 32%, and approximately 15% of underweight children simultaneously had stunting, wasting, and/or thinness. Figure 3 represents the proportions of undernutrition reflected by the different anthropometric indicators, across the seven age categories. The proportion of stunted children doubled from the age of 0–5.9 months (37%) to 24–35.9 months (80%; χ^2=11.1; p<0.01; Figure 3a). At older ages, the proportion of stunting was slightly lower but remained at a high level of 64%–69%. In the first 18 months, approximately 28%–44% of under-five children were underweight (Figure 3b). The proportion of underweight increased to 65% by 24–35.9 months of age and then decreased slightly but remained at a high level of 47%–53% at 36–60 months of age (χ^2=6.6; p<0.05). High proportions of under-five thinness (17%–21%) were observed in the first 12 months of age, but the proportions decreased from 19% to 4% at older ages (χ^2 =10.1; p<0.01; Figure 3c). The proportion of under-five wasting (11%–15%) was lower than that of thinness in the first 12 months of age, but the proportion of wasting (6%–27%) outweighed the proportion of thinness in children at older ages (χ^2=1.9; p>0.05; Figure 3d).

Phase 2

There were 54.2% and 45.8% boys and girls, respectively, with an average age of 14.1±11.7 months. Nearly one-third of children (29.9%) had low birth weight (<2500 g), whereas approximately 15.4% of children were born prematurely (<37 weeks). The average monthly household income and household income per capita were USD 277.19±299.54 (RM 926.84±1001.58) and USD 37.29±3.76 (RM 124.69±12.56), respectively.

Repeated measures ANOVA with Greenhouse–Geisser correction revealed that the mean HAZ (F=131.1, p<0.001), WAZ (F=52.0, p<0.001), WHZ (F=29.6, p<0.001), and BAZ (F=30.3, p<0.001) differed significantly from birth to 24 months of age (Figure 4). The mean WAZ was lower than the HAZ in the first 6 months. The mean WAZ was initially documented and maintained closely at −1.50 SD in the first 6 months, but it declined to approximately −2.00 SD at 15 months and remained close to −2.00 SD thereafter. The mean HAZ declined rapidly in the first 6 months, followed by a steep decline to approximately −2.50 SD at 18 months, and it fluctuated between −2.30 and −2.50 SD thereafter. The mean WHZ increased sharply to −0.40 SD at 2–3 months, declined gradually to less than −1.00 SD at 12 months, and plateaued between −1.00 and −1.30 SD thereafter. A similar pattern was observed for the mean BAZ, but the BAZ was lower than the WHZ in the first 6 months, outweighed the WHZ by 9 months of age, and remained between −0.70 and −1.10 SD thereafter.

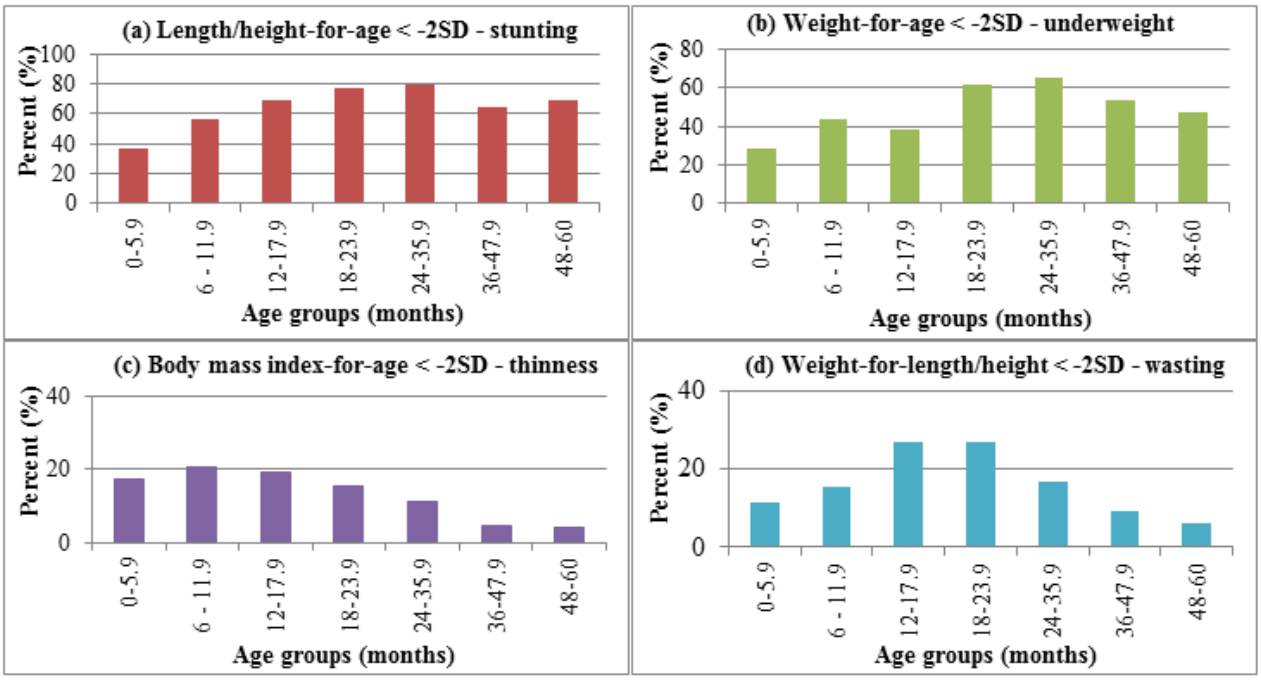

Figure 3. Undernutrition among *Orang Asli* children stratified by age groups [(a) χ^2 test for trend=11.1, p<0.01; (b) χ^2 test for trend=6.6, p<0.05; (c) χ^2 test for trend=10.1, p<0.01; and (d) χ^2 test for trend=1.9, p>0.05].

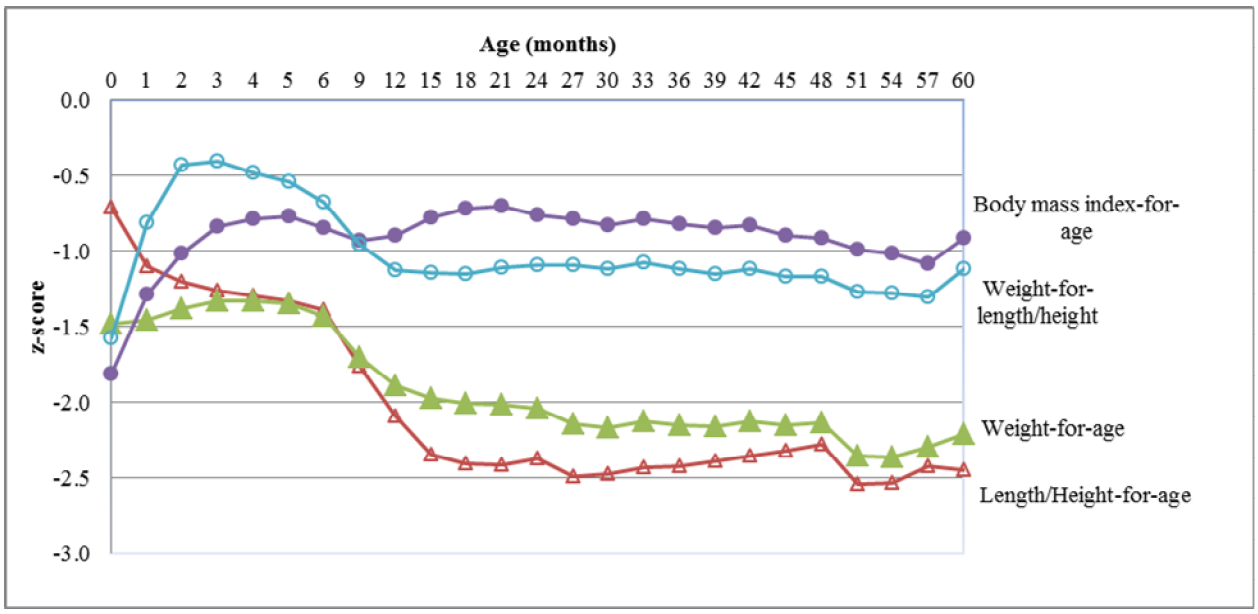

Figure 4. Mean anthropometric z-scores according to age among *Orang Asli* children relative to the World Health Organisation standard [weight-for-length/height (F=29.6, p<0.001), body mass index-for-age (F=30.3, p<0.001), weight-for-age (F=52.0, p<0.001), and length/height-for-age (F=131.1, p<0.001); Sample: 0–24 months (n=208), 27–30 months (n=154), 33 months (n=131), 36 months (n=137), 39–42 months (n=97), 45–48 months (n=88), 51–54 months (n=40), and 57–60 months (n=36)].

DISCUSSION

The National Health and Morbidity Survey 2015 reported that the prevalence rates of underweight, stunting, wasting, and thinness among under-five children were 12.4%, 17.7%, 8%, and 8.1%, respectively, in Malaysia.[25] Another nutrition survey described much lower prevalence rates of stunting (8.3%–8.8%) and thinness (5.2%–6%) among urban and rural children aged 6 months to 12 years.[26] In the present study, the prevalence of underweight, stunting, wasting, and thinness reported in under-five *Orang Asli* children in KWR ranged from two to seven times higher than those reported in previous national surveys. Our findings also indicated that the distributions of the WAZ, HAZ, and BAZ of the under-five *Orang Asli* children were skewed farther to the left of the WHO standard than were the distributions reported in Malaysian children.[26] Similar to previous studies on undernutrition (43%–86%) in *Orang Asli* children,[11-15] high prevalence rates of underweight (49%) and stunting (64%) were reported in the present study, indicating that child undernutrition still prevails in *Orang Asli* communities. In addition, the findings of the present study revealed that the rates of preterm birth (15%–25% vs 12%) and low birth weight (30%–32% vs 13%) in *Orang Asli* children were higher than those in the Malaysian population.[27-28] These findings indicate that greater efforts are needed to improve the nutrition situation of the *Orang Asli* population.

Our findings have demonstrated the varied distribution of nutritional status among under-five *Orang Asli* children compared with the findings of other countries. In India, the prevalence rate of wasting (28%) among under-five indigenous children was two times higher than the prevalence rate reported in the present study, although the prevalence rates of stunting (55%) and underweight (54%) were almost similar.[4] High levels of stunting (22%–75%) and much lower levels of underweight (0%–24%) and wasting (0%–4.3%) were also observed among under-five indigenous children in several Latin American countries (i.e. Brazil, Bolivia, Mexico, Peru, Ecuador, and Guatemala).[2-3,16] However, under-five indigenous children living in Australia[29] and western China[30] exhibited a much lower prevalence of underweight (7%–16%), stunting (9%–27%), and wasting (3%–11%) than that reported in our findings. These studies also revealed that under-five indigenous children experience a greater burden of underweight, stunting, and wasting than do nonindigenous children. The differences in the nutrition situation across countries could be because these indigenous communities are undergoing different demographic, socioeconomic, and nutrition transitions.

Consistent with other studies on indigenous children,[16-19] our cross-sectional data revealed that the rates of stunting and underweight among *Orang Asli* children increased throughout the first 24–36 months of life, whereas the rates of wasting and thinness increased in the first 12–18 months of life. These results were further confirmed by the cohort data analysis of the child growth patterns over the 2-year study period. LAZ and WAZ faltering were observed among *Orang Asli* children until 24 months of age, and WLZ and BAZ indicated faltering up to 9–12 months of age and were stable thereafter. Our findings have exhibited similar patterns of weight gain to that reported in an Aboriginal birth cohort in the 'Top End' of Australia, whereby the Top End indigenous infants grew well in the first 3–4 months of life, but their weight faltered to approximately −2.0 SD at 12 months of age.[20] Similarly, a retrospective cohort study revealed that 86% of indigenous infants from remote communities in northern Australia experienced growth faltering over 12 months.[22] However, the pattern and magnitude of LAZ faltering in the present study differed from the findings of a population-based longitudinal study of indigenous children from the urban areas of the Brazilian Amazon;[21] Lourenço et al[21] reported that among Brazilian Amazon infants, the LAZ increased to 0.30 SD in the first 6 months but then declined sharply to −0.83 SD at 24

months, followed by a gradual increase again to greater than −0.50 SD at 60 months and a plateau thereafter. Overall, the results of our study and some other studies demonstrated the variations in the patterns and magnitudes of LAZ, WAZ, WHZ, and BAZ faltering among indigenous children during the first 5 years of life.

There are several plausible explanations for the differences in the timing and patterns of LAZ, WAZ, WHZ, and BAZ faltering among *Orang Asli* children. Growth faltering in the first 6 months of life could partially reflect maternal short stature and intrauterine growth retardation.[31] In this sample of *Orang Asli* children, 14% had maternal short stature (<145 cm) and 15% and 30% were preterm and low birth weight infants, respectively. Suboptimal breastfeeding and an increase in infections could also contribute to a small change in the WAZ and rapid faltering of HAZ in the first 6 months.[32-33] From 6 to 24 months of age, the progressive and steeper faltering of HAZ than of WAZ is probably due to the failure of weight loss recovery from inappropriate infant and young child feeding practices and repeated morbidity due to infections, especially when accompanied by unhealthy environments and the poor utilisation of essential health and nutrition services.[32] Previous studies have stated that the majority of *Orang Asli* children in Peninsular Malaysia did not continue breastfeeding after 1 year of age and had less diverse diets and poor hygiene practices.[13-15] The stability of BAZ and WHZ within normal ranges reflects the adaptation of the low body weight to the short stature among *Orang Asli* children. However, we are currently analysing the potential determinants of growth faltering among *Orang Asli* children in the present study, and these insights could later inform on the development of preventive strategies specific for this population.

Nationally representative studies in India and Brazil have demonstrated that the prevalence rates of stunting or underweight or both were higher among indigenous children living in households with a low socioeconomic status and poor sanitary conditions and among those with low birth weight, who were not given complementary food at 6–8 months of age, were not breastfed until 12 months of age, did not achieve a minimum acceptable diet, and were hospitalised during the last 12 months.[16,19] Benefice et al[18] observed that in the *Esse Ejjas* ethnic group, subsistence activities (such as agriculture, logging, and fishing), a low food diversity index, and the presence of illness were associated with growth retardation among preschool children (aged 0–5 years) in a remote Amazonian area of Bolivia. The findings from a population-based cohort study of the Brazilian Amazon children reported that the wealth index, land ownership, and birth weight and length were positively associated with linear growth throughout childhood.[21]

There are several limitations of this study. First, the specific study location and inclusion of only certain subtribes could limit the generalisation of the study findings to indigenous peoples of Peninsular Malaysia. Second, for infants and children whose anthropometric data were obtained from health records, the use different measuring techniques and equipment could have introduced bias to the reported data. However, in government health clinics, nurses are trained to measure the weight and height of infants and young children according to a standard protocol, and the infant or adult scale is calibrated daily using a standard weight (e.g. 2 or 5 kg). Despite these limitations, this study has provided valuable insights on the timing and patterns of growth faltering, and these findings can be used for developing strategies to improve the health and nutrition of *Orang Asli* children.

In conclusion, undernutrition is prevalent among under-five *Orang Asli* children. Length rather than weight faltering was more pronounced in the early life of these children. Future studies are needed to better understand the complex interaction of factors (such as genetic, infectious, dietary, cultural, and socioeconomic factors) contributing to early-life growth retardation in the *Orang Asli* population. Such information is imperative to inform the development of nutrition-specific and culturally sensitive interventions (e.g. the promotion of appropriate infant and young children feeding practices, micronutrient supplementation or fortification, and disease prevention and management), which could potentially prevent early childhood growth retardation and improve children's nutritional status.

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AUTHOR DISCLOSURES

The authors declare that they have no conflict of interests.

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