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Evaluation of the Nutrition Status of Children Living in Social Welfare Institutions Located in China

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EVALUATION OF THE NUTRITION STATUS OF CHILDREN LIVING IN SOCIAL WELFARE INSTITUTIONS LOCATED IN CHINA

by

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Abstract

Background: The nutrition status of children living in social welfare institutions has not been well defined, yet it is estimated that there are at least two million children residing in these organizations. Previous research suggests that incidence of malnutrition is more frequent within this population. Without intervention, side effects of malnutrition can result in permanent impairments such as mental impairment, developmental delay, and low quality of life.

Objective: The purpose of this study was to evaluate the nutrition status of children residing in social welfare organizations over the course of three months.

Participants/Setting: 108 children residing in social welfare institutions in China, ages 2 to 13 years, were included in this retrospective analysis.

Main Outcome Measures: Evaluation of nutrition status was measured based on height-for-age, weight-for-age, body mass index-for-age, and weight-for-length z-scores which were subsequently translated into the World Health Organization's classifications for stunting, underweight status, and wasting. Average difference between z-scores was measured at the initial and 90-day assessment marker. Hemoglobin, indicating anemia, was measured as an as an additional factor of nutrition status.

Statistical Analyses Performed: The Wilcoxon Signed Rank test was used to assess change in z-scores at the initial and 90-day assessment. Change in stunting, underweight status, wasting and anemia classification was measured using the McNemar's test. A p value of <0.05 was considered statistically significant.

Results: At their initial assessment, 46.5% of children were stunted, 42.9% were classified as underweight, and 20.6% demonstrated signs of wasting. There were no significant changes in average z-scores; however, there was significant change in average hemoglobin concentration and number of children classified as underweight, wasted, or anemic between assessments.

Conclusion: Prevalence of stunting and underweight status is high for children living in social welfare institutions in China. The unsubstantial amount of nutritional change indicates that nutrition interventions need to be prioritized in these organizations to prevent consequences of chronic malnutrition

Introduction

Malnutrition (including undernutrition, inadequate intake of vitamins and minerals, and diet-related noncommunicable disease) is a problem impacting countries globally.[1,2] The World Health Organization (WHO) recognizes the impact of suboptimal nutrition, developing a strategy in 2012 targeted toward the burden of maternal, infant, and child malnutrition.[3] The incidence of pediatric malnutrition has declined since 2012; however, it is estimated that approximately 151 million were impacted by stunting and 51 million children showed signs of wasting in 2017.[2] Poor nutrition serves as a cornerstone for the continuation of the poverty cycle for children born into low socioeconomic conditions.[4,5,6]

Inadequate nutrition in early years of life, even for a short period of time, can permanently alter health outcomes.[7] Consequences of malnutrition during childhood include lack of growth, developmental delays, decreased immune function, and diminished intellectual capacity.[7-9] These ramifications, described in Figure 1, can assist in the appropriation of the cycle of poverty by decreasing skills, education, and financial stability.

Social welfare institutions (SWI) like orphanages and care centers located in underdeveloped and developing countries are at heightened risk for nutrition-related challenges. Nutrition difficulties of children within these organizations include lack of access to a variety of food, decreased growth potential, increased incidence of stunting and wasting, and intellectual and motor delays.[10-15] Mechanisms to assess and define nutritional status in this population have not been well developed and researched in SWI. In previous studies, analysis of nutrition status was focused on the assessment of anthropometric values, classification of stunting and wasting,

dietary patterns, and micronutrient levels.[10-15] These studies focused on nutrition analysis at a single point in time. Currently, there are no known studies within the population that address changes in nutrition status over the course of stay in SWI.

Within these studies, results estimating occurrences of low nutrition status have been wildly variant. Incidence of stunting have ranged from 10% to 38% in sample populations, and incidences of wasting range from 15% to 24%.[10,12,13,15] Multiple studies report that grains and starchy vegetables comprise the majority of meals with some suggesting inadequate caloric intake and suboptimal provision of micronutrients.[12,13] Insufficient and varying results reinforce the need for further investigations into the nutritional status of this population.

This study evaluates the nutrition status of children living in SWI located in China. Research focused towards this subpopulation has concentrated on orphans with parental loss related to Acquired Immunodeficiency Syndrome (AIDS).[15] Despite China's economic growth, the WHO recognizes China has having high levels of undernutrition primarily affecting less economically developed regions and children, women, and older adults.[2]

Review of Literature

Role of Malnutrition in the Cyclic Nature of Poverty

The cycle of poverty describes a series of events resulting in the continuation of low socioeconomic conditions for future generations. The cycle can account for a variety of circumstances but tends to focus on the interrelations between lack of resources, decreased skills

and productivity, reduced financial stability, and negative health outcomes[4]. Side effects of malnutrition play a critical role in the appropriation of the poverty cycle.

Diminished health and nutrition during pregnancy is associated with complications such as delayed fetal development and premature birth increasing the risk of children born with long term health complications.[16,17] Undernutrition and inadequate micronutrient intake throughout childhood can cause further impairment. Childhood malnutrition has been associated with increased mortality, poor mental development, low physical capacity, and impaired quality of life.[7-9] Side effects of malnutrition prevent educational opportunity and skill development associated with reduced financial stability, and continuation of an impoverished lifestyle where access to food and appropriate healthcare are limited.[5]

Nutrition Status of Children Living in Social Welfare Institutions

There is limited research regarding the incidence of malnutrition in SWI; however, several research studies suggest increased risk of malnutrition. A study based in Kazakhstan conducted by Hearst et al. evaluated the nutrition and developmental status of children under the age of three living in ten different social welfare institutions[10]. This was a single assessment study including 286 children. Anthropometric data including weight and height; biochemical markers including hemoglobin, albumin, and vitamin D; and Bayley Scores measuring mental and motor development were collected. Data demonstrated that 22.1% of participants exhibited stunting and 36.7% showed signs of wasting.[10] Biochemical markers indicated high incidence of anemia and vitamin D deficiency, while Bayley Scales of Infant Development Scores showed the population overall displayed motor and intellectual delay.[10]

A study in Lebanon conducted by El-Kassas and Ziade researched the burden of malnutrition and diet in school-aged children living in orphanages. Researchers focused on children living in SWI experienced increased vulnerability, physical and behavioral problems recognized in the population[12]. El-Kassas and Ziade included 150 children, ages five to fourteen, in the study. Height and weight were measured; clinical examination was conducted including evaluation of skin, hair, and muscles; a food frequency survey was included; and physical activity was assessed.[12] They concluded from the data collected that: 9.2% of participants were overweight or obese, about 3% of children exhibited signs of muscle wasting, and more than half of participants were estimated to have inadequate intake of vegetables, fruits, protein, and dairy.[12] Approximately 14% of participants showed signs of stunting a proportion comparable to sample populations in Ghana, Kenya, and Bangladesh.[11-14] The study further discussed that it should be the role of the state, authorities, and caregivers to provide proper care to children living in SWI.

Nutrition Status of Children Living in Social Welfare Institutions in China

Research of the SWI in China is insufficient. A study conducted by He and Ji in 2015 analyzed the nutritional status and quality of life in orphans in the rural Henan Province of China. The study matched 93 children aged 8 to 15 who had lost one or both parents because of Acquired Immunodeficiency Syndrome (AIDS) to a child living of similar background, with no history of AIDS, living in a familial household as a control.[15] Nutritional status was measured based on height, weight, skinfold measurements (triceps and subscapular), and hemoglobin concentration. Quality of life was measured based on the Inventory of Subjective Life Quality for Children and Adolescents and psychological wellbeing was measured using the Beck Depression Inventory and Self-Esteem Scales.[15] The study found little nutritional differences between children living

in SWI and the control sample but noted that BMI significantly differed between the two groups. Overall, approximately 6% of all participants exhibited stunting and 12% demonstrated signs of wasting.[15] In addition to nutritional status, the study reported that children living in SWI exhibited worse psychological health and quality of life.

Assessment of Nutrition Status

The United Nations Children's Fund (UNICEF) and WHO have suggested use of z-score for the analysis and reporting of nutrition status in children under five years old[18]. Both organizations recommend analysis of weight-for-age (WAZ), length/height-for-age (HAZ), weight-for-length (WFLZ) z-scores as indicators of underweight status, stunting defined as low height for age, and wasting referring to low weight for height.[18] Underweight status, stunting, and wasting indicating inadequate growth have been positively associated with negative health outcomes.[1,2,8,19,20]

The Academy of Nutrition and Dietetics (AND) and the American Society for Parenteral and Enteral Nutrition (ASPEN) have made a consensus statement for the identification of malnutrition in pediatric populations in the United States. The statement discusses identification of malnutrition for a single assessment and for multiple assessments when information is available.[21] When only a single assessment is available WFLZ, body mass index-for-age z-score (BAZ), HAZ, and mid-upper arm circumference (MUAC) z-score can be used to classify mild, moderate, and severe malnutrition.[21] AND and ASPEN suggest the use of two assessments for the classification method for childhood malnutrition using weight gain velocity (for children under 2 years), weight loss (for patients 2-20 years), deceleration in HAZ, and inadequate nutrient intake as indicators.[21]

In addition to anthropometrics, biochemical data plays a key role in evaluation of micronutrient status. In 2011, the WHO estimated that 42% of anemia in children could be resolved with regular iron supplementation[2]. Iron deficiency is estimated to represent up to 30% of low hemoglobin cases; however, other micronutrient deficiencies including folate and B12, infection, and genetic predisposition could result in anemic conditions.[2,22] Though not included in either the WHO or AND and ASPEN criteria for childhood malnutrition, anemia is recognized as a critical health indicator for children and pregnant women. A study conducted by Rahman et al. in 2019 compared the incidence of malnutrition to anemia in children under the age of five in Bangladesh.[23] The study included approximately 1500 children and assessed anthropometric measurements and hemoglobin concentration.[23] Incidence of anemia was found to be more frequent in children with low BMI and stunting.[23] Additionally, the study noted that children who were stunted were at greater risk of developing anemia if their mothers were anemic during pregnancy.[23]

Materials and Methods

Ethical Considerations

Data from this study was collected from Holt International between January 2015 and December 2018. Participants were de-identified prior to data analysis to protect confidentiality. This study was conducted in accordance with the University of Memphis Institutional Review Board who deemed that the study did not meet the criteria for human subject's research and was exempt from IRB approval.

Access to and Use of Data

Collection of data was conducted by Holt International staff and not by the primary investigator (PI). All data received by the PI was de-identified by staff at Holt International. Holt International develops programs for the critical care and support of orphaned and vulnerable children by leading the global community in finding families for children who need them and providing the pre- and post- adoption support and resources needed. Data was translated and re-coded to meet the needs of the study being conducted. Data was then analyzed using the WHO Anthro Software further detailed below.

Purpose

The purpose of this retrospective explorative study was to identify nutrition risk and change in nutrition status based on anthropometric measurements translated to WHO z-scores and hemoglobin concentration of children living in SWI in China.

Eligibility Criteria

Children aged 2- 13 years of both sexes with an initial and 90-day assessment were included in this study. For the purpose of the study, 90-day assessment included a second assessment 90 ± 14 days following the date of the initial assessment. Children under the age of 2 were excluded from the study due to differing feeding habits. Some individuals with known health conditions were included to promote a well-rounded interpretation of the overall population living in these institutions[24]. Children with physical disabilities impacting growth and development such as cerebral palsy and Down's Syndrome were not included in this study as they would have been better assessed on alternative growth charts specific to those populations. Participants with known conditions such as intellectual disabilities, autism, visual or hearing impairment, or those

with condition not known to impact growth were included. Narrowing of the research population is exhibited in Figure 2.

Anthropometric and Biochemical Measurements

Anthropometric measurements included in this study were height and weight. Both measurements were utilized to calculate body mass index (BMI). Biochemical measures included in this study were hemoglobin concentration. Hemoglobin concentration was translated to non-anemic, mild, moderate, or severe anemia in accordance to the WHO classification described in Table 1.

Classification of Stunting, Underweight Status, and Wasting Using Z-Scores

HAZ, WAZ, BAZ, and WFLZ were calculated utilizing the World Health Organization database software described in Table 1.[25,26] Per WHO criteria, WAZ was analyzed for children under the age of 10. BAZ was used for children 5-13 years of age, and WFL was used for children 2 - <5 years of age[26]. Mild wasting criteria was described per the AND/ASPEN and Texas Children's hospital guidelines to further distinguish nutrition risk.[21, 27]

Disclaimer[25,26]: The WHO Anthro Survey Analyzer runs in its own protected environment and its access is SSL encrypted; uploaded data is not saved once you close the session. However, the data will be temporarily stored in the cloud hosting the application and thus users are advised to ensure data is de-identifiable. All reasonable precautions have been taken by WHO to verify the calculations performed by this application. However, the application is being distributed without warranty of any kind, either express or implied. The responsibility for the use and interpretation

of the application's output lies with the user. In no event shall the World Health Organization be liable for damages arising from its use.

Statistical Analysis

Frequencies, means, and medians were used to describe the population, anthropometric values, z-scores and WHO classifications. The Wilcoxon Test was used to assess change in z-scores between the initial and secondary assessment. Change in stunting, underweight status, wasting, and anemia classification were measured using the Mcnemar's test. A p-value of <0.05 was considered statistically significant for both non-parametric tests. All analyses were performed using R (R Core Team 2018).[28]

Results

Initial Population Characteristics

This study was comprised of 64 boys and 44 girls. Age of children was grouped into two categories, children less than 5 and children greater than 5 years old, based on the use of WHO growth charts. Of the 108 children included in the data analysis, 45 (42%) had a known disability or health condition. At initial assessment, 35 (32%) of children were stunted, 44 (41%) were underweight, and 30 (28%) children showed signs of wasting. Children excluded from analysis demonstrated z-scores considered to be outliers in accordance to the WHO exclusion criteria and classifications of z-scores were demonstrated in Table 1. Etiology of poor nutrition status at baseline is unknown given the circumstances. Characteristics of this sample population are further detailed in Table 2.

Change in Z-Scores, Stunting, Underweight Status, and Wasting Classification

At initial assessment average HAZ was -1.76, WAZ was -1.05, BAZ was +0.59, and WFLZ was -0.34 respectively. Average z-scores were considered within normal growth parameters at initial assessment. There was slight positive change in HAZ, WAZ, and WFLZ; however, change in values were insignificant ($p > 0.05$) (Table 3). Among the children meeting study inclusion criteria, 35 (32%) of children were stunted, 44 (41%) were underweight, and 30 (28%) children showed signs of wasting at initial assessment. Although there was a non-significant difference in average z-scores, there was a significant positive change in movement from stunted and wasted classification to normal categories ($p < 0.01$) (Table 4).

Change in Hemoglobin Concentration and Anemia Classification

Initial hemoglobin concentration of 11.94 g/dL shifted negatively to 11.74 g/dL at the 90-day assessment ($p<0.05$) as demonstrated in Table 3. Negative change in hemoglobin was also demonstrated in change in anemia classification. 15% of participants were classified as having some degree of anemia and 85% displayed hemoglobin concentration within normal limits. At the 90-day assessment 25% of participants were classified with anemia and 75% maintained normal hemoglobin levels.

Discussion

In 2015, UNICEF reported that national occurrence of stunting was 9.9% and occurrence of underweight status was 3.6% suggesting increased likelihood of malnutrition indicators for children living in SWI.[27,29] The Prolongation of childhood malnutrition can be the result of insufficient diet, and lack of understanding of individualized needs.[11-14] Previous research focused on populations living in SWI has suggested that organizations are unable to provide an adequate and well-rounded diet to residents.[12,13] A nutrition analysis comparing meals offered in a SWI located in Ghana compared to the Recommended Dietary Allowance (RDA) showed inadequate provision of fat and carbohydrates, low mean intake of micronutrients, and limited purchasing of fruits and vegetables.[13] Similarly, a study in Bangladesh reported inadequate intake fruits and vegetables, insufficient dairy intake, and low meal satiety.[14] Provision of all nutritional needs and diverse food groups is a critical component of nutrition intervention within the SWI populations.

Anemia is often associated with iron deficiency; however, other micronutrients and macronutrient deficiencies such vitamin B12, folate, vitamin A, and protein insufficiency can also result in anemia. In addition to nutritional deficiencies, anemia is correlated to genetic predispositions and certain health conditions.[22,29,30] Several studies suggest that hemoglobin concentration is best associated as a marker for overall health quality.[2, 31]

Uncontrolled anemia can cause short term symptoms of irritability, tiredness, and pica which if untreated can result in diminished growth and development and cognitive decline. The etiology of anemia is variant for each individual; however, the WHO suggests that up to 50% of child

anemia could be resolved with iron supplementation[2]. Evaluation of each child's condition and possible need for nutrition supplementation or intake of micronutrients is imperative to preventing the prolongation of anemic conditions.

Similar to other research examining the SWI population, this study suggested that there is further need for nutritional intervention for children living in SWI located in China. It is the role of the caregivers, SWI, and government to provide adequate resources to promote growth and development for children living in these organizations. For children with underlying nutrition risk and malnutrition lack of intervention can result in permanent consequences such as insufficient energy, decreased intellectual function, increased risk of infection, and increased risk of mortality. These negative outcomes can promote an impoverished lifestyle characterized by lack of education and skills for the work force, illness, and minimal access to healthcare which may continue for future generations.

Strengths

To the knowledge of the authors this is the first study to analyze nutrition status in relation to length of stay within a SWI. Incidences of stunting and wasting fall within the range of previous research of SWI in different countries.[12-16]

Limitations

Limitations of this research study coincide with inaccuracies of a retrospective study including inadequate standardization methods. Though healthcare professionals were trained on appropriate measurement techniques variances, misinterpretation, and errors of data entry may

have occurred. Additionally, lack of available literature and research may skew frequency of reported malnutrition indicators. Given the circumstances of children in this study, it should be noted that past medical information was restrictive.

Conclusion

More research is needed to define the nutrition status of children living in social welfare institutions. Current research suggests increased prevalence of stunting, underweight status, wasting, and anemia within this community. A variety of factors can impact the incidence of malnutrition of children residing in these organizations; however, it is critical for staff and healthcare providers to be aware of individualized needs. Development of a pediatric nutrition risk and malnutrition screening tool would greatly benefit this population. Further research is needed to assess current pediatric nutrition screening tools and necessary components for this population. In addition to a nutrition screening tool, education regarding nutritional needs and conditions for caregivers and staff would strengthen future interventions. When childhood malnutrition continues unnoticed or is prolonged, permanent consequences like decreased intellectual function and impaired growth and development become more likely. These impairments can play a critical role in the future outcomes and quality of life for each child.

Appendix 1

Figure 1: Relationship of Hunger and Malnutrition and the Poverty Cycle

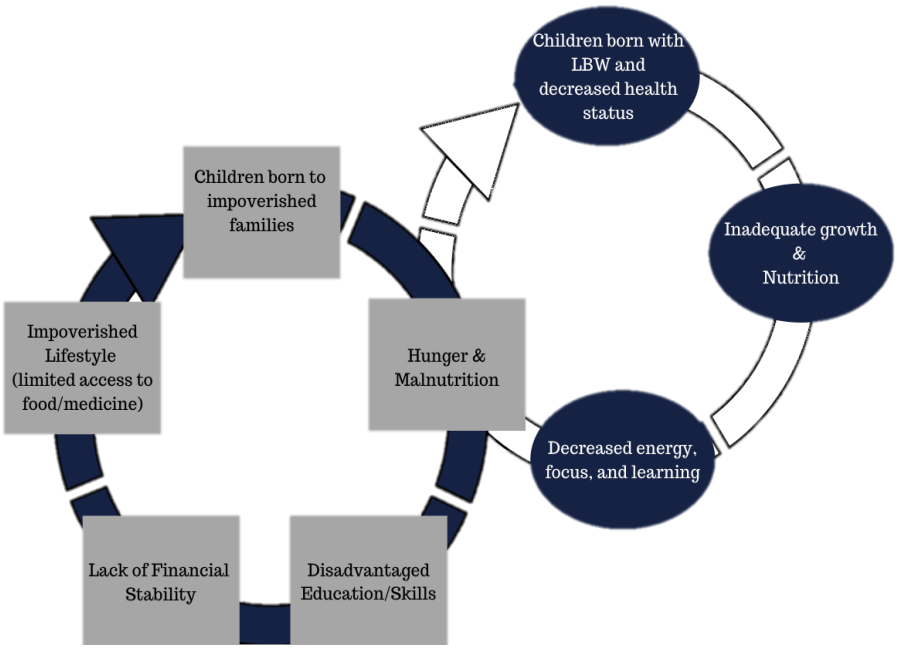

Figure 2: Sampling Procedure for the Evaluation of Nutrition Status of Children Residing in Social Welfare Institutions Located in China

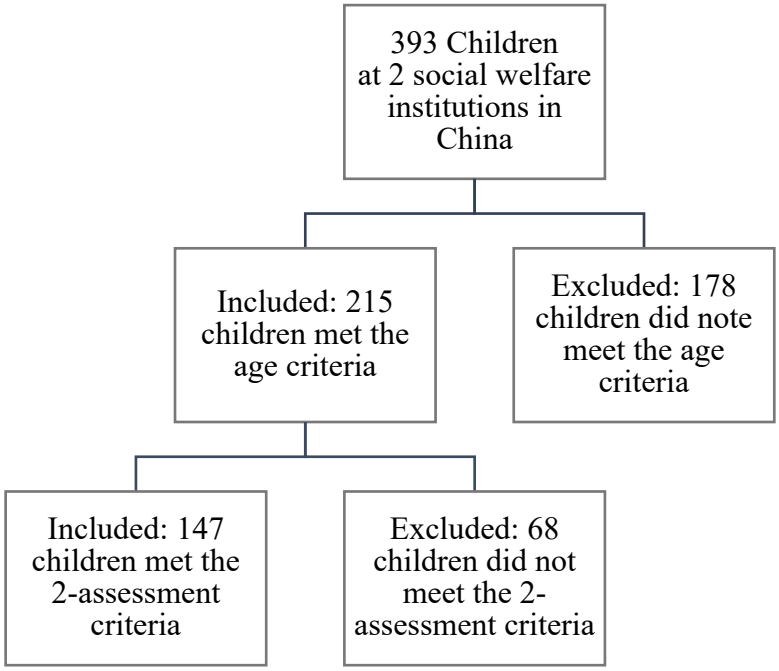

Table 1: Z-Score Criteria for the Classification of Nutrition Status

Z- Score	Growth Indicators			
	Length/Height-for-Age	Weight-for-Age (Children less than 10)	Weight-for-Length/Height (Children less than 5)	BMI-for-Age (Children 5 and older)
Above 2.00			Overweight	Overweight
Above 1.00				
Below -1.00			Mildly Wasted	Mildly Wasted
Below -2.00	Stunted	Underweight	Wasted	Wasted
Below -3.00	Severely Stunted	Severely Underweight	Severely Wasted	Severely Wasted

Table 2: Description of Characteristics of 147 Children at Initial Assessment Living in a Social Welfare Institution

Characteristic		Total n	Incidence	% of Total
Sex		108		
	Male		64	59.3%
	Female		44	40.7%
Initial Age (years)		108		
	2 to <5		66	61.1%
	5 to 13		42	38.9%
Age at 90-Day Assessment(years)		108		
	2 to <5		85	57.8%
	5 to 13		62	42.2%
Disability		108		
	Yes		45	41.7%
	No		63	58.3%
Stunting at Initial Assessment		107		
	Not Stunted		69	64.5%
	Moderately Stunted		19	17.8%
	Severely Stunted		15	14%
	Excluded		3	2.8%
Weight Status at Initial Assessment		101		
	Not Underweight		72	71.3%
	Underweight		18	17.8%
	Severely Underweight		11	10.9%
Wasting at Initial Assessment		108		
	Not Wasted		75	69.4%
	Mildly Wasted		17	15.7%
	Moderately Wasted		8	7.4%
	Severely Wasted		5	4.6%
	Excluded		3	2.8%
Anemia at Initial Assessment		105		
	No Anemia		89	84.8%
	Mild Anemia		11	10.5%
	Moderate Anemia		3	2.9%
	Severe Anemia		2	1.9%

Table 3: Difference in Average Z-Scores between Initial and 90-Day Assessment

		Total n	Mean at Initial Assessment	Mean at 90 Day Assessment	Difference	p-value
Anthropometrics						
	Height-for-Age Z-score	104	-1.76	-1.63	0.13	0.42
	Weight-for-Age Z-score	99	-1.05	-0.99	0.06	0.93
	BMI-for-Age Z-score	39	0.59	0.45	-0.14	0.52
	Weight-for-Length Z-score	64	-0.34	-0.26	0.08	0.78
Biochemical Measures						
	Hemoglobin (g/dL)	104	11.94	11.74	-0.2	0.03

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