Trends in Maternal and Child Malnutrition Indicators in Japan

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ABSTRACT

Objective: This study aimed to describe prevalence and trends in Japan in nutritional indicators/nutritional status, according to the Global Nutrition Monitoring Framework on Maternal, Infant and Young Child Nutrition (WHO, 2014).

Methods: We used vital statistics data on birth weight since 1951. Height and weight data for children, adolescents, and women of reproductive age, and hemoglobin concentration data for women were obtained from the National Nutrition Survey of Japan (NNS-J) and National Health and Nutrition Survey of Japan (NHNS-J). Underweight and overweight/obesity was defined using the percentage of overweight (POW) and body mass index (BMI). Anemia was defined as hemoglobin < 12 g/dL in non-pregnant women. Status on primary outcome indicators for the six global nutrition targets were observed regardless of data availability of annual trends.

Results: A high prevalence and increasing trends were observed in low birth weight (< 2,500 g) infants since 1975. Trends in the nutritional status among children under 5 years were unclear. Obesity (POW ≥ 20%) among school-aged children has declined. There were high percentages of underweight (BMI < 18.5 kg/m²) among adolescents and young women, with increasing trends since 1980. The percentage of overweight/obesity was consistently high among women aged ≥ 20 years. A high prevalence of anemia was consistently found among women of reproductive age since 1997.

Conclusions: Progress on reducing Japanese maternal and child malnutrition remains challenging. Continuous assessment of key indicators of maternal and child nutritional status will help to shape future strategies to encourage health and well-being through the life course.

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preschool children was 13.4% in 2015, and growth curves from national nutrition surveys for 1948-2005 showed that Japanese girls were more overweight in childhood but thinner in young adulthood in more recent cohorts, compared with older cohorts. There is a high demand to address issues of maternal and child malnutrition in Japan; however, some indicators that are commonly used in Japan make international comparison impossible, as well as age categories that differ from international standards to assess trends in published reports of nationally representative data. Therefore, some nutritional status indicators for Japan have used incomplete or estimated data from the World Health Organization (WHO) or the United Nations Children’s Fund.

In May 2012, the 65th World Health Assembly endorsed the “Comprehensive Implementation Plan on Maternal, Infant and Young Child Nutrition,” which included six Global Nutrition Targets: reducing stunting and wasting in children aged under 5 years, halting the epidemic of obesity, reducing anemia in women of reproductive age, reducing low birth weight (LBW), and increasing the rate of exclusive breastfeeding. To reinforce these six targets, the Global Nutrition Monitoring Framework (GNMF) on Maternal, Infant and Young Child Nutrition set 20 indicators from a public health perspective including policy environments, in line with the SDGs. It is critical to monitor progress on these indicators because the targets, including a 50% reduction in anemia among women of reproductive age, are quite ambitious but are also clearly important in accelerating the achievement on the national indicators identified in Health Japan 21 (the second term), which is a national health promotion plan from April 2013 to March 2023 in accordance with Health Promotion Act, and Healthy Parents and Children 21 (the second term), which is a national campaign from April 2015 to March 2025 to improve maternal and child health status. Therefore, it is necessary to monitor the long-term trends using the latest data on international indicators. The present study aimed to describe the national trends in maternal and child malnutrition indicators in Japan.

II. Method

We used open-access data to assess the indicators of maternal and child health and nutrition in Japan. These data were collected through national surveys conducted by Japan’s Ministry of Health, Labour and Welfare. Mean values for continuous variables and prevalence or percentage for categorical variables were calculated according to the survey years. We described the national trend of each indicator in the GNMF which we could access the data. As primary outcome indicators in the GNMF were important to assess the status of maternal and child health and nutrition, data on many of them were not available but we indicated values in Japan. We particularly focused on the 2015 values in Japan, similar to the SDGs for which the 2015 data is considered as a baseline. For the “prevalence of infants born < 2,500 g,” which is among the primary outcome indicators in the GNMF, vital statistics data on birth weight were obtained from 1951 to 2018. LBW was defined as an infant having a birth weight < 2,500 g. For the “prevalence of exclusive breastfeeding in infants aged six months or less”, a primary outcome indicator in the GNMF, data in 2001 was obtained from the First Longitudinal Survey of Newborns in the 21st Century (First LSN21).

For “prevalence of low height-for-age/low weight-for-height in children under five years of age,” which are among the primary outcome indicators in the GNMF, data on stunting (low height-for-age) and wasting (low weight-for-height) were obtained from the 2010 National Growth Survey on Preschool Children (NGSPC). Length/height was measured using a neonatometer/stadiometer to the nearest 0.1 cm. Body weight was measured to the nearest 10 g in NGSPC. For the “prevalence of overweight in school-aged children and adolescents 5-19 years (BMI-for-age > +1 SD),” an intermediate outcome indicator in the GNMF, we alternatively used data on overweight in children aged 2-14 years obtained from the 2015 National Nutrition Survey on Preschool Children (NNSPC). Data on overweight among school-aged children and adolescents 5-19 years (BMI-for-age > +1 SD), an intermediate outcome indicator in the GNMF, we alternatively used data on overweight in children aged 2-14 years obtained from the 2015 National Nutrition Survey on Preschool Children (NNSPC). Data on overweight among school-aged children and adolescents 5-19 years (BMI-for-age > +1 SD), an intermediate outcome indicator in the GNMF, we alternatively used data on overweight in children aged 2-14 years obtained from the 2015 National Nutrition Survey on Preschool Children (NNSPC). Data on overweight among school-aged children and adolescents 5-19 years (BMI-for-age > +1 SD), an intermediate outcome indicator in the GNMF, we alternatively used data on overweight in children aged 2-14 years obtained from the 2015 National Nutrition Survey on Preschool Children (NNSPC). Data on overweight among school-aged children and adolescents 5-19 years (BMI-for-age > +1 SD), an intermediate outcome indicator in the GNMF, we alternatively used data on overweight in children aged 2-14 years obtained from the 2015 National Nutrition Survey on Preschool Children (NNSPC). Data on overweight among school-aged children and adolescents 5-19 years (BMI-for-age > +1 SD), an intermediate outcome indicator in the GNMF, we alternatively used data on overweight in children aged 2-14 years obtained from the 2015 National Nutrition Survey on Preschool Children (NNSPC). Data on overweight among school-aged children and adolescents 5-19 years (BMI-for-age > +1 SD), an intermediate outcome indicator in the GNMF, we alternatively used data on overweight in children aged 2-14 years obtained from the 2015 National Nutrition Survey on Preschool Children (NNSPC).
school-aged children and adolescents aged 6–14 years were obtained from the National Health and Nutrition Survey of Japan (NHNS-J) from 2006 to 2017. Underweight and overweight/obesity was defined with the percentage of overweight (POW) classification using the School Health Statistics Survey method, which is commonly used as a reference in Japan. Underweight was categorized as having a POW ≤ −20%, and obesity was categorized as having a POW ≥ 20%. POW (%) was calculated using the following formula:

\[ \text{POW} = 100 \times \frac{\text{measured weight}}{\text{standard weight}} - 100 \]

Standard weight is the age- and sex-specific weight-for-height based on the data in the Japanese Ministry of Education, Culture, Sports, Science and Technology’s Annual Report of School Health Statistics 2000. The formula for calculating standard weight is as follows:

\[ \text{Standard weight (kg)} = \text{A} \times \text{height (cm)} - \text{B} \]

and the details of the coefficients A and B have been described elsewhere.

In the National Nutrition Survey of Japan (NNS-J) (1975–2002) and the NHNS-J (2003–2017), height was measured barefoot to the nearest 0.1 cm with a stadiometer, and weight was measured in light clothing to the nearest 0.1 kg. BMI (kg/m\(^2\)) was calculated as weight (in kg), divided by the square of height (in m). The details of the NHNS-J design have been described elsewhere.

In 2011, three prefectures (Iwate, Miyagi, and Fukushima) were excluded from the survey due to the Great East Japan Earthquake. In 2012 and 2016, an expanded survey was conducted to ensure a sufficiently large sample for subnational analyses. For the data of 2012 and 2016, where the method of cluster sampling was different from other years, weighting was performed to adjust for differences between the number of households in each prefecture.

Data on underweight and overweight/obesity among adolescents aged 15–19 years were obtained from the NNS-J and the NHNS-J from 1975 to 2017. Underweight was defined as BMI < 18.5 kg/m\(^2\), and overweight/obesity was defined as BMI ≥ 25 kg/m\(^2\). Data on BMI outliers and pregnant women were excluded. Until 1985, data on lactating women were excluded.

The “proportion of women aged 15–49 years with low body mass index (< 18.5 kg/m\(^2\))” and “proportion of overweight and obese women 18+ years of age (body mass index ≥ 25 kg/m\(^2\))” which are intermediate outcome indicators in the GNMF, were assessed using data on underweight and overweight/obesity among women aged 20 years or older from the NNS-J and the NHNS-J from 1980 to 2016. Underweight was defined as BMI < 18.5 kg/m\(^2\), and overweight/obesity was defined as BMI ≥ 25 kg/m\(^2\).

For the GNMF’s primary outcome indicator of “prevalence of hemoglobin < 11 g/dl in pregnant women and prevalence of hemoglobin < 12 g/dl in non-pregnant women,” data on women’s hemoglobin concentration were obtained from the NNS-J and the NHNS-J from 1997 to 2017. Anemia was defined as hemoglobin < 12 g/dl in non-pregnant women aged 20 years or older. Those who were taking drugs to treat anemia were excluded in 2009 and 2010.

### III. Results

**Primary outcome indicators for the six global nutrition targets in the GNMF**

Status in Japan on primary outcome indicators for the six global nutrition targets in the GNMF was shown in Table 1. The prevalence of stunting and wasting in children under five years of age in 2010 was 7.1% and 2.3%, respectively. The prevalence of hemoglobin < 11 g/dl in pregnant women aged 20–49 years old was 22.9% in 1995–1999, whereas the prevalence of hemoglobin < 12 g/dl in non-pregnant women aged 20–49 years old was 21.5% in 2015. The prevalence of LBW infants born was 9.5% in 2015 and the prevalence of exclusive breastfeeding in infants aged six months or less was 21.0% in 2001. The prevalence of overweight in children under six years of age was 13.4% in 2015.

**Birth weight**

Dramatic declines were observed in the total number of live births and the live birth rate: The number of infants born was 1,386,981 (live birth rate: 32.0 per 1,000 population) in 1900, 2,086,091 (live birth rate: 34.9 per 1,000 population) in 1925, 2,337,507 (live birth rate: 28.1 per 1,000 population, total fertility rate: 3.65) in 1950, 1,901,440 (live birth rate: 17.1 per 1,000 population, total fertility rate: 1.91) in 1975, 1,190,547 (live birth rate: 9.5 per 1,000 population, total fertility rate: 1.36) in 2000, and 1,005,721 (live birth rate: 8.0 per 1,000 population, total fertility rate: 1.45) in 2015. Trends in the prevalence of LBW infants born and in the mean birth weight (kg) from 1951 to 2018...
are shown in Figure 1. Vital statistics from 1951 to 1975 showed that increasing trends in mean birth weight were observed (3.14 kg for boys and 3.06 kg for girls in 1951, and 3.24 kg for boys and 3.15 kg for girls in 1975), whereas declining trends in the prevalence of LBW infants born were reported (7.3% in 1951, and 5.1% in 1975). However, vital statistics from 1975 to 2015 showed that declining trends in mean birth weight were observed (3.07 kg for boys and 2.99 kg for girls in 2000, and 3.04 kg for boys and 2.96 kg for girls in 2015), whereas increasing trends in the prevalence of LBW infants born were reported (8.6% in 2000 and 9.5% in 2015).

Underweight and obesity among school-aged children

Trends in the prevalence of underweight (POW ≤ −20%) and obesity (POW ≥ 20%) among school-aged children and adolescents aged 6–14 years are shown in Figure 2. In 2015, the prevalence of underweight was 4.3%, and the prevalence of obesity was 5.5%. Obesity has declined since 2006. The prevalence of underweight was high in 2011,
especially among boys (11.6%).

**Underweight and obesity among adolescents**

Trends in the prevalence of adolescents aged 15–19 years who were underweight (BMI < 18.5 kg/m²) and overweight/obese (BMI ≥ 25 kg/m²) are shown by sex in Figure 3. In 2015, for both boys and girls, the prevalence of underweight adolescents was 19.8%, and this prevalence has gradually increased over the past 30 years. The prevalence of boys who were overweight/obese was 6.6%, and the prevalence of girls who were overweight/obese was 3.4%.

**Underweight and overweight/obesity among women aged 20 years or older**

Trends in the percentages of underweight (BMI < 18.5 kg/m²) and overweight/obesity (BMI ≥ 25 kg/m²) among women aged 20 years or older are shown in Figure 4. In 2015, the percentage of overweight/obese women was 19.2%, and this figure has remained steady over the past 30 years. The percentage of underweight women was 11.1% in 2015, reflecting a gradual increase since 1980. A particularly high percentage of underweight was observed among young women aged 20–29 years (22.3%).
Anemia in women

Trends in the prevalence of anemia and the mean hemoglobin concentration among women aged 20 years or older are shown in Figure 5. In 2015, the prevalence of anemia in women aged 20-49 years was 21.5%, and the mean hemoglobin concentration among women aged 20 years or older was 12.9 g/dL. Over the past 20 years, the high prevalence of anemia has remained unchanged.

IV. Discussion

The present article has described the trends in maternal and child malnutrition indicators in Japan, using data from nationally representative cross-sectional surveys over an extended period of time. Among primary outcome indicators for the six global nutrition targets in the GNMF, data on annual trends of these indicators except for “prevalence of infants born < 2,500 g” were not available in Japan. Although Japan has made progress on several indicators, including the relatively low prevalence of overweight/obesity in children and adolescents, we found that maternal and child nutrition remained a challenge in Japan in 2015: Japan had a high prevalence of LBW infants (9.5%), high percentages of underweight among adole-
cents (19.8%) and young women aged 20–29 years (22.3%), a high percentage of overweight/obese women aged 20 years or older (19.2%), and a high prevalence of anemia among women aged 20–49 years (21.5%).

The high prevalence of LBW infants (9.5%) observed in 2015 reflected an increasing trend over the past 40 years. Given the low total fertility rate (1.45 in 2015) and declining trends in the number of births, even if women of reproductive age were to improve their health and living environments, these improvements would be insufficient to enable them to give birth free from anxiety. As preterm deliveries and multiple gestations are contributing factors in the increase in the prevalence of LBW infants in Japan, dietary instruction for adequate quality and quantity as well as mental health support would be required for pregnant women. National data on trends in the GNMF primary outcome indicator of the “prevalence of exclusive breastfeeding in infants aged six months or less” are not available in Japan, but a low exclusive breastfeeding rate (21.0%) was reported for the country in 2001. There may be further improvement in recent years, as the 2015 NNSPC showed that the “prevalence of exclusive breastfeeding in infants aged three months” was 54.7%. However, WHO recommends mothers worldwide to exclusively breastfeed infants for the child’s first six months to achieve optimal growth, development, and health. Moreover, a systematic review in the Cochrane library also supports exclusive breastfeeding for the first six months of life in both developing and developed countries. Because support from husbands/parents has been identified as an important factor for continuing breastfeeding, it is essential to further promote an environment in which people around mothers actively engage in raising children, such as taking childcare leave at work, in order to help mothers continue breastfeeding as long as possible.

As for infants and young children, national data on trends in the GNMF primary outcome indicator of the “prevalence of low height-for-age/weight-for-height > +2 SD/low weight-for-height in children under five years of age” are not available for Japan in published reports of NHNS-J. Although stable trends in average length/height and weight have been described for 1940–2010, a high prevalence of stunting in children under five years was reported (7.1%) in the 2010 NGSPC. Moreover, a high prevalence of overweight among preschool children under six years old was observed (13.4%) in the 2015 NNSPC. The main reasons why we were unable to describe the annual trends of stunting, wasting, and overweight in children under five years of age were because infants less than 1 year old are not included in NHNS-J, and the collected annual data of infants and young children aged 1–5 years is small to show as a national representative data. In NGSPC, infants and young children from 14 days after birth to under 78 months old are measured their length/height and weight, but the survey is conducted every 10 years. Moreover, we generally use Japanese growth reference, not WHO growth reference to evaluate the nutritional status in infants and young children in local community settings, which makes international comparisons impossible. Therefore, further research to assess current trends in the nutritional status of infants and young children using international indicators is essential.

Among school-aged children, the prevalence of underweight and obesity, defined by POW, were 4.3% and 5.5%, respectively, in 2015. As there are relatively many overweight/obese children in three prefectures where excluded from the survey due to the Great East Japan Earthquake, the lack of data may partially contribute to the high proportion of underweight in 2011. Defining underweight and obesity using POW has been shown to result in underestimates of the prevalence of these physical statuses among school-aged children, compared to using BMI, as defined by the International Obesity Task Force. Using the International Obesity Task Force’s definition, increases have been observed in the average BMI and the prevalence of overweight and obesity from 1976 to 2000, especially among children living in rural areas. An increase in the prefecture-level school lunch coverage rate may be contributing to an observed reduction in the risk of overweight and obesity among boys. In Japan, school lunches are a comprehensive approach for school-aged children, offering a well-balanced diet managed by a dietitian, at a cost to parents of hundreds of Japanese yen per meal. The school lunch program is based on the School Lunch Law and the school lunch intake standards. The annual report of the School Lunch Implementation Survey for fiscal year 2018, conducted by the Ministry of Education, Culture, Sports, Science and Technology, listed the percentages of elementary schools...
and junior high schools serving school lunches as 99.2% and 89.9%, respectively. Moreover, the mean number of school lunches provided in 2018 was 191 in elementary schools and 186 in junior high schools, and the mean school lunch fee per month per capita was 4,343 yen (about USD 40) in elementary schools and 4,941 yen (about USD 45) in junior high schools. School lunch programs in elementary schools might help to reduce socio-economic disparities in diet intake27). It may be important to improve children’s growth and a healthy food environment, for example by increasing the school lunch coverage in junior high schools.

Among adolescents, a high percentage of underweight (19.8%) was observed in 2015, reflecting a gradual increase over the past 30 years. The percentages of overweight/obese boys and girls in this age group were 6.6% and 3.4%, respectively. A previously published review suggested that the prevalence of eating disorders in Japan has increased28), with adolescents with eating disorders such as anorexia nervosa and bulimia nervosa characterized by severe distress or concern about body weight or shape, and excessively controlling their eating habits to achieve an ideal weight29). A study among adolescents in the United States suggested that their body weight perceptions were potentially important risk factors for suicidal behavior30). To prevent suicide—the leading cause of death among Japanese adolescents31)—it is necessary to provide support for mental health, along with improvements in adolescents’ knowledge of health and nutrition.

In women aged 20 years or older, the percentage of underweight was 11.1% in 2015, and this has gradually increased since 1980. In terms of maternal health, the high percentages of underweight among young women in their 20s and 30s, especially, should be given more attention. Greater percentages of women who are thin among those aged 15~29 years have been observed in metropolitan areas than in small towns32). Young women had a higher “desire for thinness” compared to their measured body size, in particular, the “desire for thinness” was high for women living in metropolitan areas33). Furthermore, unhealthy dietary behavior including not eating three meals regularly was associated with underweight and weight loss in Japanese women34). Thus, the promotion of a well-balanced diet along with preventing excess weight control is important for young underweight women. The percentage of overweight/obesity among women aged 20 or older was 19.2% in 2015, and this percentage has remained stable over the past 30 years. Together, these findings show that one-third of women of reproductive age in Japan suffers from the double burden of malnutrition, which consists of the necessity of integrated actions to tackle malnutrition globally. In the United States, the National Health and Nutrition Examination Survey has shown an association between women’s obesity in pre-pregnancy and poor diet quality35). Another study has suggested that obesity may be associated with lower chances of having a live birth after assisted reproductive treatment36). Therefore, pre-pregnancy nutritional education including optimal weight control for women is essential.

In terms of deficiencies in micronutrients such as iron, the prevalence of anemia in women aged 20~49 years was 21.5% in 2015, and women of reproductive age living in rural areas have been shown to be at an especially high risk of anemia37). Moreover, pooled data from five years (1995~1999) showed that 22.9% of pregnant women (aged 20~49 years) were anemic (hemoglobin < 11 g/dl)16). Maternal anemia during pregnancy may lead to LBW and preterm delivery38). As the World Health Organization classifies a 20% to < 39.9% prevalence of anemia as a moderate public health problem39), further attention and action to combat anemia—such as distributing iron and folic acid supplements to pregnant women and socially vulnerable people—are necessary. National data on trends in the GNMF process indicator of the “proportion of pregnant women receiving iron and folic acid supplements” are not available for Japan. Alternatively, among adults in Japan aged 20 years or older, excluding pregnant and/or lactating women, the prevalence of calcium supplement users was 2.1% and the prevalence of iron supplement users was 1.4%40). Moreover, the 2015 NHNSJ found that 0.2% of people consume only tablets, instead of solid foods, at breakfast. Having said this, the improvement of appropriate literacy for supplement usage in addition to daily dietary intakes would be important. A lack of appropriate knowledge of folic acid supplement usage has been reported among pregnant women in Japan, who, for example, tended to begin supplement use for the “health of the fetus” only after pregnancy recognition41). It may also be worthwhile to discuss social interventions that
have been implemented in other countries, such as the distribution of folic acid-enriched bread.

Over the past seven decades, nationally representative data on dietary intake of NNS-J and NHNS-J have been collected every year in Japan, with quality control ensured by dietitians at the local government level. In Japan, dietitians and registered dietitians (RDs) are officially acknowledged as nutritional professionals\(^2\), \(^3\). Dietitians are authorized by prefecture governors after graduating from dietitian training facilities. As a further expert, RDs are authorized by the Ministry of Health, Labour and Welfare after graduating from dietitian training facilities and passing a national examination. They play roles in providing dietary guidance for health promotion, and RDs are considered as nutritional professionals\(^4\), \(^5\). Dietitians are responsible for the advanced dietary guidance needed for people requiring special care, such as those who are sick and hospitalized. Despite the progress Japan has made of improving the nutritional status of children and women in the national nutritional policy is important for further promoting health and well-being through the life course in Japan.

V. Conclusions

This article has described the trends in maternal and child malnutrition indicators in Japan and identified aspects that remain particularly challenging despite some progress. These include a high prevalence of LBW infants, high and increasing percentages of underweight among adolescents and young women, a high percentage of overweight/obesity among women aged 20 years or older, and a high prevalence of anemia among women of reproductive age. The assessment of these key indicators will help to shape development strategies to improve health and well-being through the life course in Japan.

Conflict of Interest

None declared.

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国際栄養指標に基づく日本の母子栄養状態の推移

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【目的】国際的な栄養指標に基づき、日本の母子栄養状態の状況と経年変化を記述することを目的とした。

【方法】世界保健機関が定めた国際的な栄養モニタリングの枠組みで設定された20の指標のうち、人口動態調査と国民健康・栄養調査の公開データにより入手可能な指標（低出生体重（1951～2018年）、学童期の痩せと過体重（2006～2017年）、思春期の痩せと過体重（1975～2017年）、女性の痩せと過体重（1980～2016年）、女性の貧血（1997～2017年））の状況（割合）について年次推移を示した。さらに2015年におけるその他主要指標（完全母乳育児、乳幼児の発育阻害、消耗症、過体重）を整理した。

【結果】低出生体重児の割合は1975年までは減少傾向にあったが（5.1％）その後増加に転じた（9.5％、2015年）。5歳未満児の発育阻害、消耗症の割合はそれぞれ7.1％、2.3％（2010年）、過体重は13.4％（2015年）であった。学童期の肥満の割合は減少していた（5.5％、2015年）。思春期及び若年女性の痩せの割合は高く（それぞれ19.8％、22.3％、2015年）を1980年以降増加していた。女性の過体重・肥満は1980年以降高い割合が続いていた（19.2％、2015年）。妊娠可能年齢の女性の貧血は1997年以降高い割合が続いていた（21.5％、2015年）。

【結論】日本の母子栄養の状況は改善がみられるが、高い低出生体重児割合、高い思春期及び若年女性の低栄養（痩せや貧血）の割合の一方で中高年女性の過体重・肥満の割合が高い等課題もみられた。国内の指標に加えて、これら母子栄養の主要な指標を継続してモニタリング評価していくことは、さらなる栄養改善に役立つと考えられた。

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